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THESIS

TECHNOLOGY TRANSFER: A COMPILATION OF VARIED APPROACHES TO THE MANAGEMENT OF INNOVATION

by

Claudia Lynn Bailey

December 1982

Thesis Advisor: J. W. Creighton

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Prepared for:
Naval Facilities Engineering Command
Alexandria, Virginia

T207788

NAVAL POSTGRADUATE SCHOOL
Monterey, California

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This research was funded by Naval Facilities Engineering Command, Alexandria, Virginia.

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NPS-54-82-011
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): Technology Transfer: A Compilation of Varied Approaches to the Management of Innovation

5. TYPE OF REPORT & PERIOD COVERED: Master's Thesis December 1982

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Claudia Lynn Bailey

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Postgraduate School Monterey, California 93940

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: PE62760N N0002582WR00406

11. CONTROLLING OFFICE NAME AND ADDRESS: Naval Postgraduate School Monterey, California

12. REPORT DATE: December 1982

13. NUMBER OF PAGES: 197

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office): Naval Facilities Engineering Command Alexandria, Va 22332

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report): Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):

18. SUPPLEMENTARY NOTES:

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Technology Transfer
Innovation
Management
Research and Development
Technology
Executive Responsibility
Information Flow
Research Utilization
Organization Development

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Today's managers often find themselves at a loss when trying to deal with the vast amount of technology and innovative information available to them; they do not know how to actively implement technological innovation. The manager who desires to learn about the effective management of technological innovation and change is faced with sources too numerous and diverse to be readily accessed and integrated. A single reference is needed.

A review and analysis of the available transfer of technology data was conducted to identify those concepts, approaches and techniques that will be of assistance to managers who must recognize, evaluate and implement the technological advances within their organizations. This thesis provides a compilation of pertinent selected works on technology transfer and addresses the foundations of technology transfer; the elements of the Predictive Technology Transfer Model; applications of technology transfer; and the associated public policy issues.

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Technology Transfer: A Compilation of Varied Approaches to the Management of Innovation

by

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Lieutenant Commander, United States Navy
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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 1982

81375

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I. INTRODUCTION

Today's manager, faced with decreasing resources, increasing costs, declining numbers of personnel, and reduced budgets, is expected to overcome these constraints through resourceful improvements in efficiency or effectiveness. At the same time, he or she is expected to continually change things for the better, rather than to merely maintain a cost-effective status quo. One means of achieving these improvements is through the effective management of innovation, or change [Ref. 1: p. 10]. This involves maximizing the utility of the vast amount of technology and innovative information available by adopting and adapting it to suit the purposes of the manager's organization through approaches known as technology transfer.

What is "technology transfer"? In the literature, definitions abound. The Directory of Federal Technology Transfer defines the term as follows: "...the process by which existing research knowledge is transferred operationally into useful processes, products, or potential public or private needs...." The General Accounting Office gives this definition: "...the secondary application of technology developed for a particular mission or purpose to fill different needs in another environment...." And the National Academy of Engineering offers this explanation of the term: "The

process of collection, documentation, and successful dissemination of scientific and technical information to a receiver through a number of mechanisms..." [Ref. 2: p. 108]. These definitions are obviously similar, yet each is different enough from the next to lead to possible confusion on the part of individuals first being introduced to the concept of technology transfer. However, stripped of the minor differences among these definitions, technology transfer is simply putting something which is known into use or to a new use or application. This "transition into use" consists of bringing new ideas, knowledge, processes and products to the attention of those who might use them, and then encouraging trial and application [Ref. 3: p. 1].

To be effective, technology, ideas, and innovative information must be moved in a conscious, well planned manner. The manager cannot rely on the slow, passive diffusion of knowledge or ideas; he or she must make it happen through the dynamics of a transfer mechanism. That is, the transfer process must include a set of activities designed to effectively link or couple the source of the existing knowledge with its eventual user [Ref. 4: p. 1]. Just how this is to be accomplished is the subject of much of the literature in this growing specialized area of management. The approaches and opinions on the management of innovation are numerous and varied. A 1973 NATO conference on technology transfer, for example, identified eighteen distinct disciplines which have

provided many propositions, models, and measurement methods dealing with the nature of the transfer process [Ref. 5: p. 254].

The myriad texts, papers, and articles on the subject of technology transfer are, for the most part, written by the professionally recognized specialists in the field for a specific audience. This audience is usually either the peer group of the author (other technology transfer specialists), for whom the article addresses a specific issue or problem, or it is a company or agency for whom the article or paper is a report on a contracted technology transfer project. Thus, for a manager seeking to grasp an understanding of the management of technology transfer, it would currently be necessary to seek information from many sources. Some universities, colleges, and engineering schools offer formal courses in technology transfer, and there are good articles, reports, and journals available that describe and explain the various transfer mechanisms and models currently in the literature. However, many of these sources are not readily available to the manager. Thus, there is a need for a source that can provide managers with a general introduction to the concept of and literature on technology transfer and lend insight to the many approaches that can be taken with the same problem: the movement of information from source to user.

By compiling a collection of readings from different fields (business, government, industry, academia) and

technological backgrounds, this thesis will provide a single source from which the reader can gain an understanding of the varied approaches to technology transfer and an appreciation of technology transfer as a managerial tool. This thesis is intended as a foundation on which a text on technology transfer can be built that will enhance the capabilities of on-line managers to recognize, evaluate, and implement the technological advances within their organizations needed to overcome the constraints imposed on them by the managerial environment of limited resources.

II. DATA REVIEW AND SELECTION

The data used in this thesis are the articles, papers, texts, and contributions of their authors relevant to the general area of technology transfer. The first phase of the data review began with the approximately 350 references obtained from a computer search on technology transfer at the California State University, Sacramento. CSU, Sacramento was chosen for the initial computer search because its ongoing technology transfer program has developed an operational, on-line, interactory and computer searchable data bank, named TECTRA, that is a most convenient and available reference source of published material in the field of technology transfer. The 350 references were randomly divided into approximately 25 stacks of 14 articles. The students in the Technology Transfer class (MN 3801) at Naval Postgraduate School, Monterey, California, were used to make the "first cut" of the 350 articles (these students were all mid-grade military officers with from 8 to 14 years of management experience). They were asked to classify each document according to what subject area it should be included in in a proposed book of readings on technology transfer and to rate the stack they were given from 1 to n (1 = best, 2 = next best, ..., n = worst). The students were given an outline as a tentative chapter (subject area) division and told that

they could indicate when they thought an article might be appropriate for more than one chapter. The proposed chapters and their issues were:

Chapter I. Introduction.

What is technology transfer (T^2)?

Why is it important? (Size of storehouse of knowledge.)

Who is responsible for T^2?

Who is interested?

Large organization interest.

Small organization interest.

Push vs pull concept.

Chapter II. Economic importance of technology transfer.

NASA spinoff reports.

NASA economic studies.

Writings of A. F. Givson, Rockwell International (Contact Goldstone).

Cost effectiveness models.

Technology transfer vs R&D as a source of information.

GNP and technology transfer.

Chapter III. Technology transfer, the state of the art at the City-County-State level.

Urban technology transfer.

Bureaucratic innovation.

T^2 in law enforcement.

Chapter IV. Technology transfer, a look at the Federal sector.

Reports of "Federal Laboratory Consortium New Notes."

T^2 and public policy.

Incentives to innovate in public organizations.

Chapter V. The private sector approach to technology transfer.

T^2 and professional organizations.

Managing for technological change.

Maximizing use of technical information.

Techniques for T^2 in business.

Problems of T^2 in industry.

Chapter VI. Current and active education and training programs about technology transfer.

George Washington University.

University of Wisconsin.

I.S.R. at University of Michgan.

Naval Postgraduate School.

Technology Transfer Society.

Chapter VII. A simple model of the technology transfer process.

Concepts Framework and Methodology.

The SEAM T^2 process.

Dimensions of T^2 structure.

Chapter VIII. Methods of information documentation.

Review standard systems, i.e. reports, articles, news items, etc.

Discuss data base concepts.

NTIS, DDC, Smithsonian.

Commercial computerized data bases.

Federal computerized data bases.

Scientific and Technical Communications.

Data Banks for Research and Development.

COM and changing technology.

Chapter IX. The distribution system.

Diffusion of technological innovations.

Technological cooperation.

Barriers and gateways to distribution systems.

Chapter X. Formal organization.

Structural considerations.

General management policy and creativity.

Chapter XI. Selection process for projects.

The management of innovation.

Innovation's pace vs management's time horizon.

Project selection that picks winners.

Chapter XII. Capacity.

Functions of ignorance in T^2.

Product Utilization.

International transfer of technology.

Characteristics of technically progressive firms.

Chapter XIII. Linkers.

The role of communications in technological innovation.

The international gatekeeper.

Specialized knowledge of linking roles.

Chapter XIV. Credibility.

Effectiveness of four methods of presenting evidence.

Source credibility and interpersonal trust.

Source credibility and persuasion.

Chapter XV. Perceived reward.

Tailoring incentives for innovators.

Structuring of rewards.

Creativity and productivity programs.

Sharing profits.

Chapter XVI. Willingness to be helped or to help.

Innovation resistance.

Job security, technical innovation and productivity.

Responsible management.

Chapter XVII. Technology transfer, basis for developed nations.

Adapting to the foreign technological challenge.

International T^2.

Foreign technology and U.S. economy.

Foreign investment and T^2.

Chapter XVIII. Technology transfer to less developed nations (LDC's).

United Nations and technology transfer.

East-West T^2: Theoretical models and practical experience.

LDC's demands for technological advances.

Chapter XIX. Technology transfer by licenses, patents and agreements.

Effects of patents on T^2.

Compensating inventors.

Inventors, innovators, compensation and the law.

Trade secrets.

Chapter XX. Stimulation and/or control by government.

Science, technology and America's future.

Government innovation in industry.

National policies.

Government technology export control.

Chapter XXI. The new world of women managers (and technology transfer).

Motivation. Objectives. Risk. Technical interest. Social pressure.

In Phase Two of the data review, the student-annotated articles were re-ordered by chapter and ranking-within-chapter. Those with ranking higher than 10 were temporarily set aside, while those with rank 1-9 were re-issued in chapter groupings to the Technology Transfer class and again ranked (original rankings were obliterated) and evaluated by the students for "fit" within the chapter indicated. The purpose of student review and involvement was primarily to determine which articles would be of interest to managers

with little prior exposure to the field of technology transfer, since article selection was purely subjective.

The thesis writer, acting as editor, then reviewed each chapter grouping to ensure that there were from 3 to 8 articles of ranking 1 to 9 per chapter. Where there were not 3 suitable articles, a chapter was either dropped (as in the case of proposed Chapters VI and XXII) or combined with a closely related chapter (as was done with proposed Chapters XVII and XVIII). Where there were more than 8 articles, the least appropriate articles were set aside. In addition to reviewing the originally selected articles, the writer also reviewed each article originally ranked higher than 10, and each volume of The Journal of Technology Transfer, from volume 1, number 1 (fall 1976) to the current issue, was reviewed in search of any articles that might be appropriate for inclusion in a chapter. Lastly, the proposed outline was reorganized, with an historical perspective chapter added, for smoother transitions between subject areas and for better readability.

III. FORMAT

This research project was begun with the intention of producing a manuscript for a book of selected readings on technology transfer. However, due to constraints of thesis length, and the excessive time that would have been required to obtain authors' and publishers' permission to print the selected articles, Appendix A of this thesis is instead a compilation of abstracts of the selections, with the appropriate section and chapter introductions. The format for the manuscript, which corresponds to the contents of Appendix A, is as follows:

Section A. Foundations of Technology Transfer

Chapter 1. An Historical Perspective

Article

1. Technology Transfer in the Navy: An Historical Analysis--D. K. Allison

2. Analysis of PL96-480--G. T. Richards

3. Technology Transfer and Utilization Studies--Examples of Navy Sponsored Effort--J. T. Rohrer and T. A. Buckles

Chapter 2. The Nature of Innovation and Technology Transfer

4. Triggering Technology Transfer--T. P. Evans

5. Technology Transfer: A Public Policy Issue--LT B. A. Bayma, Jr.

6. Dimensions of Innovation--D. C. Pelz, F. C. Munson, and L. L. Jenstrom

7. Paving the Way for Technopolis--N. V. Lateef

8. Strategies for Improving Research Utilization--A. Frohman and E. Roberts

9. Innovation and Technology Transfer: The Roles and Characteristics of Individuals--P. Jervis

10. Science, Technology, and the Human Condition--P. Handler

Chapter 3. Approaches to Technology Transfer

11. The Technology Transfer Process: Concepts, Framework and Methodology--J. A. Jolly and J. W. Creighton

12. A Study in Technology Transfer--R. D. Carnahan

13. Systems for Technological Information Transfer--W. T. Knox

14. Dimensions of Organizational Technology and Structure: An Exploratory Study--B. C. Reimann

15. Managing Change--R. M. Worcester

16. Strategic Planning for Successful Technological Innovation--R. Cooper

17. The SEAM Technology Transfer Process--E. R. Browning and G. Conning

Section B. Focus on the Elements of the Predictive Technology Transfer Model

Chapter 4. Documentation

18. TECTRA--A Data Bank of Successful Innovations--J. A. Jolly and T. A. Buckles

19. Data Banks for R and D--F. U. Wetzler

20. A Synthesis of Pertinent Research Relating to Technical Information Systems--L. A. Digman

21. The TECTRA Newsletter: Implications for Its Usefulness as an Information Diffusion Tool--S. Greathead

22. Managing the Flow of Scientific and Technological Information--T. J. Allen

23. A Crux in Scientific and Technical Communications--J. C. R. Licklider

24. The Computer in Research: A Real-Time Partner--G. A. Lavendel

25. Everything You Always Wanted to Know May Soon Be On-Line--W. Kiechel III

Chapter 5. Distribution

26. Organize for Technology Transfer--R. N. Foster

27. Technological Cooperation for World Survival--W. C. Norris

28. Word of Mouth Processes in the Diffusion of a Major Technological Innovation--J. A. Czepiel

29. Measuring the Effectiveness of a Rapid Response Technology Transfer Program--E. H. Early

30. Working Group Reports--Transportation Technology--J. Grey and M. Newman

31. Action Oriented Strategic Planning: The Concepts of Infrastructure and Functional Domains--S. N. Bar-Zakay

Chapter 6. Organization

32. Management Education, Company Climate and Innovation--H. Baugartel, L. E. Dunn, and G. I. Sullivan

33. A Study of the Technology Transfer Capability of Eleven Organizations--J. A. Jolly

34. Two Models of Corporation and International Transfer of Technology--Y. Tsurumi

Chapter 7. Project Selection

35. Management of Technology Transfer in an Advanced Project--The Case of Surveyor--W. E. Giberson

36. Project Selection Methods that Pick Winners--A. Paolini, Jr. and M. A. Glaser

37. An Evaluation System for Project Selection--M. J. Cooper

38. Factors Influencing Innovation Success at the Project Level--A. H. Rubenstein, A. K. Chakrabarti, R. D. O'Keefe, W. E. Souder, and H. C. Young

39. The Management of Innovation--D. B. Hertz

40. Implementing Change: Ten Questions to Ask--J. F. Wetjen

41. Planning--Key to Research Success--R. Stolz

Chapter 8. Capacity of Receiver

42. A Problem-Solving Package for Dissemination and Utilization of Knowledge--D. A. Lingwood

43. The Administrative Experiment: Planned Innovation and Evaluation--J. Anderson

44. Functions of Ignorance in Introducing Automation--B. Karsh and J. Siegman

45. The Effects of Technological Change--S. J. Boulier

46. Technology Transfer--Capacity Building--J. A. Jolly

47. Factors for Success in Industrial Innovation--R. Rothwell

48. The Characteristics of Technically Progressive Firms--C. F. Carter and B. R. Williams

Chapter 9. Linker Role

49. The Linker Role in Innovation--Dr. J. W. Creighton and Dr. J. A. Jolly

50. The Technological Gatekeeper: Evidence in Three Industries--J. W. Brown

51. Managing Communication Networks in R&D Laboratories--M. L. Tushman

52. Planning for Innovation Through Dissemination and Utilization of Knowledge--R. G. Havelock and others

53. The Role of Communications in Technological Innovation--R. Rothwell and A. B. Robertson

54. The International Gatekeeper--T. J. Allen, J. M. Piepmeier, and S. Cooney

55. Knowledge Linkers and the Flow of Educational Information--R. S. Farr

56. The Linker's Contribution to Technology Transfer--P. George, J. A. Jolly, and J. W. Creighton

Chapter 10. Credibility of Source and Channel

57. Communicator Credibility and Communication Discrepancy as Determinants of Opinion Change--E. Aronson, J. A. Turner, and J. M. Carlsmith

58. Commitment of Audience and Legitimacy and Attitudinal Stance of Communicator--C. A. Kiesler, M. S. Pallak, III, and R. Archer

59. Conditions Which Nurture the Application of Forest Recreation Research Results--B. L. Driver and N. E. Koch

60. Initial Attitude, Source Credibility, and Involvement as Factors of Persuasion--E. McGinnies

61. The Contribution of Studies of Source Credibility to a Theory of Interpersonal Trust in the Communication Process--K. Griffin

62. The Influence of Source Creditability on Communication Effectiveness--C. I. Hovland and W. Weis

Chapter 11. Reward System

63. New Approaches for Compensation of Inventors--W. Marcy

64. How the IBM Awards Program Works--W. J. Turner

65. Making Technology Transfer Happen--J. Gartner and C. S. Naiman

66. Tailoring Incentives for Researchers--L. R. Jauch

67. Scientists in Organizations--D. Pelz and F. Andrews

68. Industrial Research Institute Position Statement on Recognition and Rewards for Industrial Innovation--Industrial Research Institute

69. Research: How Rewards Can Be Made More Effective by Proper Structuring--A. S. King

70. Productivity from Scanlon-Type Plans--A. J. Geare

Chapter 12. Willingness

71. The Absorption Rate of Ideas--G. Gallup

72. Innovation-Resisting and Innovation-Producing Organizations--H. A. Shepard

73. Managing Technological Change: A Box of Cigars for Brad--F. W. Gluck and R. N. Foster

74. The Middle Manager as Innovator--R. M. Kanter

75. Job Security, Technical Innovation and Productivity--B. E. Peters

76. The Responsible Management of Technological Change--L. H. Peach

77. Why Innovations Fail--S. Myers and E. E. Sweezy

78. UNCSTD Was Not a Technical Failure--M. Wionczek

Section C. Technology Transfer Applications

Chapter 13. Technology Transfer at the City-County-State Level

79. Master Plan for the Future: Local Government ISPT/NSF--B. J. Reiss

80. New Findings on the Transfer of Computing Applications Among Cities--K. L. Kraemer and J. L. King

81. Bureaucratic Innovation in Urban Government: A Policy Model--R. D. Bingham

82. Industry as a Mechanism for Urban Technology Transfer--D. D. Roberts, D. L. Wilemon, and P. J. Flynn

83. Technology Transfer of Computer-Based Applications in Law Enforcement--K. W. Colton and J. M. Tien

Chapter 14. The Federal Sector

84. Technology Transfer: A Look at the Federal Sector--K. E. Egide

85. An Overview of Federal Technology Transfer--A. B. Linhares

86. Evaluation Framework for Federal Technology Transfer Initiatives--T. C. O'Brien and L. M. Franks

87. Working Group Reports--National Resource Management Technology--J. Grey and M. Newman

88. Intergovernmental Cooperation in Science and Technology--J. E. Clark

89. Department of Defense Technology Transfer Consortium: An Overview--G. F. Lindsteadt

90. Champions for Radical New Inventions--D. A. Schon

Chapter 15. The Private Sector Approach

91. Technology Transfer and Utilization: Active Promotion or Passive Dissemination--P. Wright

92. Some Problems of Technology Transfer into Industry: Examples from the Textile Machinery Sector--R. Rothwell

93. Working Group Reports--Housing and Urban Construction Technology--J. Grey and M. Newman

94. Techniques for Technology Transfer within the Business Firm--J. M. Stewart

95. Productivity and Technology in the Electric Lamp Industry--R. B. Carnes

96. Technology and Labor in Automobile Production--R. V. Critchlow

97. The Roles of Science in Technological Innovation--M. Gibbons and R. Johnston

Chapter 16. International Technology Transfer

98. International Technology Transfer: Ramifications Concerning Communist Bloc Nations--H. C. Fish

99. Adapting to the Foreign Technological Challenge--S. Gee

100. The Acceleration of International Technology Transfer--Commerce America

101. The Transfer of Technology to Developing Countries: A Critical Analysis Regarding Venezuela--M. Suarez

102. Science and Technology: Report from the President--J. Carter

103. Technology Transfer to Developing Nations--H. H. Rosen

104. The Transfer of Technology to Underdeveloped Countries--G. Myrdal

Section D. Public Policy Issues

Chapter 17. Economic Considerations of Technology Transfer

105. Impact of the Space Shuttle Program on the National Economy--C. M. Merz, T. A. Gibson, and C. W. Seitz

106. Technology, Productivity, and Economic Growth--Mosaic

107. How to Spot a Technological Winner--G. R. White and M. B. Graham

108. Investment in Innovation--A. M. Bueche

109. The Role of Marketing in Technology Transfer--T. M. Jacobius and R. S. Levi

110. Technology and Economics: Problems or Answers--J. Sweeney

111. Technology Exports Can Hurt U.S.--J. Baranson

Chapter 18. Technology Transfer by Licenses, Patents, and Agreements

112. Patents--Impediment or Expedient to Technology Transfer--T. E. Elsasser

113. Technology Transfer--Hard Sell for Software--P. Harrison

114. The Patent Issue--Effects of the Patent System on Innovation--Ray Thornton

Chapter 19. Stimulation and/or Control by Government

115. Federal Office for Technology Transfer: A Congressional Perspective--S. D. Underwood

116. Science, Technology, and America's Future--IEEE Spectrum

117. Government Intervention and Innovation in Industry: A Policy Framework--W. J. Abernathy and B. S. Chakravarthy

118. Towards New National Policies to Increase Industrial Innovation--F. Press

119. Compensating Employed Inventors in Europe--W. R. Steckelberg

120. Small Is Beautiful--Technology as if People Mattered--J. S. Bortman

121. The GAO's View of Federal Focus for Technology Transfer--O. T. Fundingsland

Chapter 20. Technology Transfer's Relation to Security and National Defense

122. Computers, Privacy and the American Public--K. M. Suess

123. Offshore Technology Transfer--D. J. Looft

124. Thinking Ahead: Communications Technology--for Better or for Worse--D. Bell

125. Technology: Dichotomous Tool--T. G. Lombardo

126. Exploding a Few Myths about Productivity and Presenting a Formula for the Future--J. F. Bucy

APPENDIX A

AN ORGANIZED COMPILATION OF WORKS ON TECHNOLOGY TRANSFER

A.1. SECTION A. FOUNDATIONS OF TECHNOLOGY TRANSFER

Management is an applied professional activity. Thus, the manager who wishes to enhance his or her managerial capabilities for handling matters related to the management of technological innovation or change would be well advised to observe how the transfer of technology is accomplished by successful managers and organizations. An understanding of the nature of innovation and how technology is moved from source to potential user also provides the manager with the perspective needed to realize its relevance to his or her job. Furthermore, in attempting to manage technological innovation within an organization, the manager will benefit from an appreciation for the historical factors that have influenced the development of technology transfer as a concept and field of study. The introductory chapter focuses on the history of technology transfer as a field of study and as a requirement under the law. In chapter 2, attention is given to the overall concept of technology transfer and the role innovation plays in management. Chapter 3 undertakes a review of several approaches to the application of technology transfer.

These chapters in Section A provide a foundation for the study of the remainder of the text. The sections following this initial foundation section undertake to demonstrate and explain the basic managerial functions involved in the application of technology transfer as a managerial tool, as well as the issues relevant to technology transfer in the public and private sectors and within the organization.

A.1.1. Chapter 1. An Historical Perspective

TECHNOLOGY TRANSFER IN THE NAVY: AN HISTORICAL ANALYSIS

David K. Allison

Abstract

The Stevenson-Wydler Technology Innovation Act of 1980 focused new attention on the subject of technology transfer. Among many other provisions, the law requires increased emphasis on improving the transfer of knowledge and other resources of Federal laboratories to State and local governments and to private industry. To explain the reasons for this legislation, Congress reported a number of findings. Those of particular significance to technology transfer were:

1. Many new discoveries and advances in science occur in universities and Federal laboratories, while the application of this new knowledge to commercial and useful public purposes depends largely upon actions by business and labor.

2. No comprehensive national policy exists to enhance technological innovation for commercial and public purposes.

3. It is in the national interest to promote the adaptation of technological innovations to State and local government uses.

The remedies the Congress proposed to correct the shortcomings it found were, to a certain extent, merely further movement along a traditional path--dissemination of Federal resources to a private sector and local governments. But the law also contained a number of new initiatives designed to make significant changes in the operations of Federal laboratories.

This paper examines sections of the new legislation in the context of a general review of the subject of technology transfer to which they relate. Analysis of this background of the legislation should help those involved in implementing it to act reasonably and responsively.

Allison, David K., "Technology Transfer in the Navy: An Historical Analysis," paper prepared by the Historian of Navy Laboratories, May 1982.

ANALYSIS OF PL96-480

Gerald T. Richards

Abstract

Public Law 96-480, formerly called S.1250 and officially called The Stevenson-Wydler Technology Innovation Act of 1980, passed both houses of Congress in September and was signed by the President on October 21, 1980. This memorandum examines PL96-480 and House of Representatives Report No. 96-1199, the committee report, to interpret the law. The report is an official part of the legislative history of the law and is used by the courts to determine the "intent of Congress" when interpreting legislation. This memorandum is restricted primarily to outlining the obligations and options of Lawrence Livermore National Laboratory under this new law.

Richards, Gerald T., "Analysis of PL96-480," paper presented to the Energy and Resource Planning Branch of Lawrence Livermore National Laboratory, November 26, 1980.

TECHNOLOGY TRANSFER & UTILIZATION STUDIES-- EXAMPLES OF NAVY SPONSORED EFFORT

J. T. Rohrer and T. A. Buckles

Abstract

Since 1969, the Navy has been sponsoring technology transfer methodology and effectiveness meausrement studies at the Naval Postgraduate School, Monterey, California. This paper outlines some of the significant findings as the result of this effort and the attempts of one Navy organization to put some of this knowledge into use. These technology transfer studies and reports have been grouped into two broad categories:

(a) Methodology research which concerns the mechanisms which cause technology to transfer and the theory associated with the transfer, and

(b) Measures of Effectiveness or Utilization which is the actual quantification of effectiveness.

The authors include an excellent brief review of the Predictive Model of Technology Transfer and all the factors affecting the transfer mechanism.

Rohrer, J. T., and Buckles, T. A., "Technology Transfer & Utilization Studies--Examples of Navy Sponsored Effort," pp. 23-46 in Creighton, J. W., and Jolly, J. A. (ed), Technology Transfer: Research Utilization and User Stimulation, Naval Postgraduate School, Monterey, California, 1980.

A.1.2. Chapter 2. The Nature of Innovation and Technology Transfer

TRIGGERING TECHNOLOGY TRANSFER

Thomas P. Evans

Abstract

This article discusses the problems of moving technical ideas and know-how from a conceiving organization (the seller) to a user organization (the buyer). Evans states that the movement of new products and process ideas from seller to buyer is an important instrument of commerce that needs cultivation and encouragement.

He first discusses what the buyers are looking for and then what the sellers are looking for. He discusses various problems involved from both points of view. Evans points out that the buyer is overreluctant to take risks, and the seller is overconfident of the value of his technology. Therefore, a transfer gap exists between the two.

To remedy this gap Evans lists several points of advice to the buyer and to the seller. These are points he feels will help with the transfer.

He summarizes the article by concluding that the gaps caused by sharp differences in the backgrounds and points of reference of potential buyers and sellers can be bridged. He says the secret ingredient of a successful technology transfer which he calls "the trigger" is mutual respect and better

understanding between those who have technology for sale and those who can use it.

Evans, Thomas P., "Triggering Technology Transfer," Management Review, pp. 26-33, February 1976.

TECHNOLOGY TRANSFER: A PUBLIC POLICY ISSUE

LT B. A. Bayma, Jr.

Abstract

Technology and the dissemination of information has become a public policy issue in the United States. This article examines the concept of technology transfer and the issue of exporting technological innovation by providing an historic overview of the process and the private and public sector's attitude towards the transfer of technology.

Bayma, Jr., LT B. A., "Technology Transfer: A Public Policy Issue," Journal of Technology Transfer, 3(2), pp. 43-51, 1979.

DIMENSIONS OF INNOVATION

Donald C. Pelz, Fred C. Munson, and Linda L. Jenstrom

Abstract

Within a conceptual framework of three dimensions, this paper examines parallels between the process of innovation in shipbuilding and in nursing care. Major conclusions are:

1. A given innovation must include not only technological change but also embedding activities to ensure its fit into the adopting organization.

2. To ensure continuation of the innovating process, it is necessary to build innovative capacity, with leadership vested in some person or group.

3. System-wide innovation requires both an effective diffusion process and diffusion capacity, to disseminate knowledge about specific innovations and also about ways to build innovative capacity.

4. Building both innovative capacity and diffusion capacity must be seen as responsibilities of the entire organization or system.

Pelz, Donald C., Munson, Fred C., and Jenstrom, Linda L., "Dimensions of Innovation," Journal of Technology Transfer, 3(1), pp. 35-49, 1978.

PAVING THE WAY FOR TECHNOPOLIS

Noel V. Lateef

Abstract

The direction headed is toward a technopolis--a uniformly technologized world. With the accumulation of capital, the diffusion of technology has made production characteristics of national economies more similar. The invisible hand of economic interdependence is fostering a new technological regime.

The monopoly an innovating country enjoys on a new product can be deceptively temporary. The most important fact about a new technology is the knowledge that it can work. With this knowledge any nation with a reasonably sophisticated technical capacity of its own can duplicate a technological development more cheaply than its originator, even without technology transfer.

With considered policies toward global industrialization, real world production can rise substantially. However, existing knowledge of the industrialization process is too limited, localized and unsystematic, and its applicability to current and emerging needs too unexplored, to provide an adequate basis for effective industrialization policies. An enlightened technological regime will be the essential factor in the successful application of this approach.

Lafeef, Noel V., "Paving the Way for Technopolis," Bulletin of Atomic Scientists, v. 35, pp. 58-61, November 1979.

STRATEGIES FOR IMPROVING RESEARCH UTILIZATION

A. Frohman and E. Roberts

Abstract

The authors state that technological innovation is implemented and adopted through a series of phases. Efforts to increase utilization from research ideas have not always been successful. The authors outline a better approach to alter earlier stages of the entire innovation process in order to select and utilize research that is more likely to be used. For effective research utilization to occur, a very diverse set of activities must be carried out. Industrial organizations have brought marketing and management personnel into the research and development organization. Achieving effective utilization of research requires careful planning, staffing and execution of the research effort to take into account what is necessary to facilitate utilization of the results. While no practice guarantees utilization of the results, the approaches examined in the article increase the probability that the research output will be adopted by its target user.

Frohman, A., and Roberts, E., "Strategies for Improving Research Utilization," Technology Review (March/April 1978), pp. 33-39.

INNOVATION AND TECHNOLOGY TRANSFER-- THE ROLES AND CHARACTERISTICS OF INDIVIDUALS

Paul Jervis

Abstract

Project SAPPHO, which studied differences between success and failure in innovation, produced information both on the roles played by individuals in the innovation process and on the characteristics of those associated with success. Although the data do not permit as detailed an analysis as other studies which have concentrated specifically on gathering information about people, they do enable some of the existing ideas to be reviewed. Results show little support for the belief that "Product Champions" can challenge and overcome organizational unsuitability or indifference, but suggest rather that the power, commitment and experience of the Innovation Managers are crucial factors.

Jervis, Paul, "Innovation and Technology Transfer--The Roles and Characteristics of Individuals," IEEE Transactions on Engineering Management, v. EM-22, no. 1, pp. 19-27, February 1975.

SCIENCE, TECHNOLOGY, AND THE HUMAN CONDITION

Philip Handler

Abstract

The impact of science and engineering on citizens is great, despite their questionable impact on social institutions. While technology has been clearly beneficial to many people, it has been of dubious value in improving man's social condition. Government, personal, and family relations are not better--and may even have deteriorated--since the advent of sophisticated technologies. This article is a broad overview of science and technology-directed change in the human condition in the United States. The intent is not to be exhaustive but rather to stimulate thought and debate.

Handler, Philip, "Science, Technology, and the Human Condition," IEEE Spectrum, pp. 49-52, August 1979.

A.1.3. Chapter 3. Approaches to Technology Transfer

THE TECHNOLOGY TRANSFER PROCESS: CONCEPTS, FRAMEWORK AND METHODOLOGY

James A. Jolly and J. W. Creighton

Abstract

The concepts, framework and methodology of the technology transfer process are discussed. On the basis of research a model of the transfer mechanism is developed. This model is carried through several iterations to arrive at a predictive model of technology transfer. The model is useful in terms of exposing deficiencies in the acceptance of new and/or innovative technology. In addition the model has a future usefulness in terms of providing a basis for a quantitative measure of the effectiveness of an organization to capitalize on the technology transfer process.

Jolly, James A., and Creighton, J. W., "The Technology Transfer Process: Concepts, Framework and Methodology," Journal of Technology Transfer, 1(2), pp. 77-91, 1977.

A STUDY IN TECHNOLOGY TRANSFER

R. D. Carnahan

Abstract

Technology transfer has been an inherent element in the growth of Gould Inc. from its origins in a small Lake City, Minnesota foundry in 1869 to a major electrical/electronics firm with sales of over $2 billion per year in 1979. Technology transfer can be viewed as the pivotal element in the economic prosperity of individual business elements as well as entire business enterprises.

The transfer process, increasingly the focus of study by government, industry, and academia is at times smoothly subtle and at times turbulent. Study of the process is motivated by the belief that it will produce a level of understanding that will both facilitate and accelerate the movement of technology from the laboratory to the marketplace.

Experience, properly analyzed, can be one of our best teachers; to that end some specific cases of technology transfer are discussed representing recent and current experiences with the process. The author then discusses some of the determinants for success in the transfer process as viewed subjectively by a participant/observer.

Carnahan, R. D., "A Study in Technology Transfer," Keynote Address, Technology Transfer Society Fifth Annual Meeting and International Symposium, Las Vegas, Nevada, June 22-24, 1980.

SYSTEMS FOR TECHNOLOGICAL INFORMATION TRANSFER

W. T. Knox

Abstract

The article discusses the meaning and application of technology transfer in modern society by focusing on its problems, users, and implications. The author calls technology 'how to' and includes all the supporting theory, evaluation of alternatives, equipment processes, materials and facilities, and supporting procedures and techniques. The essential ingredient in a successful technology transfer is the blending of a problem with a solution. The idea is to find a problem that can be solved with an existing technology rather than by researching a new solution to that problem. Problems exist for technology transfers in the form of time constraints, lack of familiarity with those who might make use of the technology, and the training to use the technology. The author feels the effectiveness of the transfer depends on information condensers, transformers, and filters and are required in proportion to the volume of information, number of users, and the type of system being used.

Knox, W. T., "Systems for Technological Information Transfer," Science, pp. 415-419, August 1973.

DIMENSIONS OF ORGANIZATIONAL TECHNOLOGY AND STRUCTURE: AN EXPLORATORY STUDY

Bernard C. Reimann

Abstract

Including a review of pertinent literature, the author develops a model for describing process technology along the dimensions of the degree of utilization of mass-production, and the degree of technical change.

Analysis of data from a study of 19 manufacturing organizations showed organizational size and dependence were more strongly related to specialization and formalization of structure than were use of mass production technology or the degree of change over time in manufacturing technology. The implication is that structural specialization (horizontal and vertical differentiation of functions and degree of professionalism) appears to be more a function of organizational size than of its manufacturing technology. Similarly, formalization of organizational activities have more to do with a relationship (or lack thereof) to a parent organization than to technology.

Centralization of decision making was not found to be related to size, dependence, or either dimension of technology. However, firms involved in unit to batch production (low-mass-production) were found to be negatively related in terms of technical change rate to degree of centralization.

Correspondence between structure and technical change was found only in low-mass-production, implying that an organization's response to changes in technology may be contingent on the form of its technology. If the form is flexible, the organization is free to adjust its internal structure to demands of the environment. If the form is mass-production, it may be inhibited.

Reimann, Bernard C., "Dimensions of Organizational Technology and Structure: An Exploratory Study," Human Relations, pp. 545-566, June 1777.

MANAGING CHANGE

Robert M. Worcester

Abstract

While most organizations are able to adjust to small routine changes in their systems, it often requires a re-thinking of traditional management practices to accomplish large-scale tasks which cut across departmental lines. The introduction of wholly new products or services, conducting a major reorganization, effecting acquisitions and mergers, entering new markets and radically improving internal efficiency and profitability are some of those innovations that may require a change in management practice. There is a feeling among middle management of most companies, however, that the company is incapable of change. Study results also show that managers believe companies reward those who use safe, tested methods rather than those attempting to implement new ideas. To reconcile this need for change with the belief that change is impossible and unrewarding, top management must rethink some popular assumptions about what stimulates better performance. Top management should also realize that only a small few "change promoters" will be available at any level within the organization. The majority of employees fall somewhere in between the category which actively promotes change and the category which actively resists change. While people of both extremes are necessary in every

organization, conditions inherent in most corporations favor stability and make necessary the creation of conditions more favorable to change.

Worcester, Robert M., "Managing Change," Long Range Planning, vol. 3, no. 1, pp. 31-35, September 1970.

STRATEGIC PLANNING FOR SUCCESSFUL TECHNOLOGICAL INNOVATION

Robert Cooper

Abstract

The author begins by stressing the importance of strategic planning for new product development. The firm should carefully evaluate the nature of the business they are in and strive to develop new products to satisfy their target market. It appears that all too often, a successful product development program is the result of luck rather than planning.

When defining the firm's business sector, management should take a wide perspective. The author gives the example of a railroad, defining their business in the broad terms of transportation rather than railroading. This will enable the firm to consider relevant market opportunities that they might otherwise overlook. The company should carefully evaluate their strengths and weaknesses as well as those of their competitors in relation to their business sector.

Once the firm's business sector has been defined the company will have a basis to establish their new product development guidelines. The definition will give management a criterion in evaluating proposed new product ideas. Additionally, it will give direction to research and development efforts.

Cooper, Robert, "Strategic Planning for Successful Technological Innovation," The Business Quarterly," pp. 46-54, Spring 1978.

THE SEAM TECHNOLOGY TRANSFER PROCESS

Edwin R. Browning and Gene Colling

Abstract

The Surface Environment and Mining Program, known as SEAM, was established by the Forest Service in 1973 and given a five-year mission to develop and apply the most current reclamation and planning technology. SEAM is concentrating its efforts in the West because of keen interest in developing new energy and mineral deposits.

The research, planning, and application projects underway are primarily directed toward helping Forest Service land managers effectively handle mineral management problems. However, SEAM-generated information is also being used by other federal and state agencies, mining companies, and decision makers at all levels.

SEAM projects cover the whole spectrum of mining activity; from pre-exploration, exploration, leasing, and development; through final reclamation. Model demonstration sites have been established thorughout the West to develop and demonstrate the most current reclamation technology.

Major emphasis is being directed toward developing technology transfer systems that will funnel available knowledge to the various user groups in an understandable and usable form.

This paper concentrates on five steps identified as being critical to assure technology transfer: (1) need identification, (2) information development, (3) packaging, (4) transfer, and (5) application.

Browning, Edwin R., and Colling, Gene, "The SEAM Technology Transfer Process," a report prepared for the Technology Transfer Workshop, Tucson, Arizona, February 12-15, 1979.

A.2. SECTION B. FOCUS ON THE ELEMENTS OF THE PREDICTIVE TECHNOLOGY TRANSFER MODEL

In this section, we initiate the study of the technology transfer process. The Jolly/Creighton technology transfer model presented in the previous section provides a framework for a better understanding of the approaches to and concepts of technology transfer. The chapters in this section focus on the nine technology transfer elements which have been described and discussed in that model as being useful in assessing proposed transfers. Chapter 4 is concerned with methods of documentation, such as currently successful data banks of technology transfer information. Chapter 5 deals with some of the many ways that information movement is effected. Characteristics of both formal and informal organizations impacting on the transfer of technology are the focus of Chapter 6. Chapter 7 concerns such factors as the nature of a successful project, procedures and standards for selection, and planning the assignment of resources. In Chapter 8, the capacity of the person or organization to receive innovation is the focus. The role and contribution of the linker in the transfer of technological innovation is examined in Chapter 9. Chapter 10 discusses some of the factors affecting the credibility of transfer transaction, such as the assessment by the potential receiver of the reliability of the information, its source, and its presenter and the assessment by the sender of the ability

of the receiver to understand or use the information. The effects of reward systems on the transfer and implementation of technological innovation are considered in Chapter 11. Lastly, Chapter 12 looks at how the desire or resistance to accept and use innovation impacts on technology transfer, and addresses the manager's role in decreasing resistance.

The selections in Section B reflect the complexity of technology transfer and the relevance of the nine factors which contribute to successful transfers of technology into use. An understanding of how these elements affect people and organizations enables the manager to merge the theory of information movement with management theory, and contributes to the manager's effectiveness with technological innovation.

A.2.1. Chapter 4. Documentation

TECTRA--A DATA BANK OF SUCCESSFUL INNOVATIONS

James A. Jolly and Thomas A. Buckles

Abstract

An operational, on line, interactory and computer searchable data bank has been developed at California State University, Sacramento. The data bank is named TECTRA. The project has been a joint effort of the Federal Laboratory Consortium and the School of Business and Public Administration, CSUS. TECTRA is a data bank of cases describing either hard or soft technology that has been developed by federally supported effort and then transferred to (used by) a public sector organization (city, county, etc.) or by the private sector. Each case in the data bank is flagged by five different key words (descriptors). An updated key word list is maintained on line for the user. Searches of the data bank may be made by several independent classifications such as the name of the technology source, the year first used, etc.

This paper discusses the objectives of the project TECTRA, the current status of the data bank and includes a report describing the interest and use by the public sector (cities, counties, states).

Jolly, James A., and Buckles, Thomas A., "TECTRA--A Data Bank of Successful Innovations," Technology Transfer Society Symposium 1980, 10-1 - 10-10.

DATA BANKS FOR R AND D

Fred U. Wetzler

Abstract

Knowing where to get reliable scientific data--and how to use it--can make the difference between a cost-effective research and development project and an economic disaster. Scientific data bases are proliferating, but their compilers haven't always been telling where they are or what they offer.

This article provides an excellent overview of what data are available (as of 1977) and where they are. Both computer-readable and noncomputerized scientific numeric data bases are listed and described. The author includes both government and industrial data bases in his discussion.

Wetzler, Fred U., "Data Banks for R and D," Research/Development, pp. 54-56, 58-59, 62-64, June 1977.

A SYNTHESIS OF PERTINENT RESEARCH RELATING TO TECHNICAL INFORMATION SYSTEMS

L. A. Digman

Abstract

The purpose of this article is to evaluate pertinent research concerning technical information systems in general and technology in particular. This research evaluation was undertaken to (1) determine the state-of-the-art with regard to organizational technical information systems, and (2) to provide the background knowledge necessary for the development of interorganizational technical information systems to facilitate effective technology transfer.

The author investigates, evaluates and summarizes pertinent research on technical information systems (TIS)--the vehicle by which technology is disseminated and acquired by potential users of that technology. Since the TIS is a critical element in the transfer process, it is recommended as the place to begin--employing the principles of systems analysis and design--to optimize transfer of technology.

Digman, L. A., "A Synthesis of Pertinent Research Relating to Technical Information Systems," Journal of Technology Transfer, 3(2), pp. 37-42, 1979.

THE TECTRA NEWSLETTER: IMPLICATIONS FOR ITS USEFULNESS AS AN INFORMATION DIFFUSION TOOL

Sheila Greathead

Abstract

Statement of Problem: To develop and test the usefulness of the TECTRA Newsletter, a mechanism for disseminating information about technology transfer and the TECTRA data base. Current literature was used to show the emerging importance of technology transfer and the Newsletter's role in this area.

Sources of Data: Primary data was collected from the recipients of the Newsletter. This included technology transfer agents, administrators of various municipal government departments, and some executives in private enterprise.

Conclusions Reached: It was shown that the TECTRA Newsletter created interest in the cases reported by the Newsletter, as well as awareness of the TECTRA data base. It was also shown that the Newsletter is regarded as a useful tool by readers, and should therefore be viewed as an on-going project.

Greathead, Sheila, "The TECTRA Newsletter: Implications for Its Usefulness as an Information Diffusion Tool," Journal of Technology Transfer, 4(2), pp. 59-79, 1980.

MANAGING THE FLOW OF SCIENTIFIC AND TECHNOLOGICAL INFORMATION

T. J. Allen

Abstract

The author attempted to show how behavioral scientists have become more interested in the flow of technical information between scientists and engineers. His original research studied evidence, which spanned a ten year period. He studied parallel projects (two or more R&D teams assigned to the same set of problems) of the test groups to ascertain whether differences in information gathering techniques, problem solving techniques and relative performance existed between the groups. His results showed that differences exist since scientists are found to rely more heavily upon written than oral sources of information, while technologists tend to favor oral information sources. Other results included the observation that for technologists, the organization to which they belonged tended to impede the communication flow.

Allen, T. J., "Managing the Flow of Scientific and Technological Information," submitted to the Alfred Sloat School of Management as a Doctoral Dissertation, August 22, 1966.

A CRUX IN SCIENTIFIC AND TECHNICAL COMMUNICATIONS

J. C. R. Licklider

Abstract

Licklider says, "It is a flood of information and not a flood of knowledge that is causing the trouble with which we must cope." He contends that we have come to an age wherein it is impossible for an individual to keep up with his field. "For most of us, the flood of information is a major factor in our lives. It is markedly affecting what we do and how we do it." He suggests three ways in which to control the flood: "(a) reduce the rate of publication, (b) improve the arrangements for selecting pertinent documents, and (c) improve the arrangements for processing the information the documents contain." Licklider discards the first method as being "naive." There is little hope for the second method, he says, because it is too time-consuming and the supply of qualified people is limited. The third method is the "only credible promise for development of an effective system of informational flood control." He concludes that computer programs tend to become public and available to all users if they have wide applicability. This will require a close interaction between people and computers.

Licklider, J. C. R., "A Crux in Scientific and Technical Communications," American Psychologist, pp. 1044-1051, November 1966.

THE COMPUTER IN RESEARCH: A REAL-TIME PARTNER

G. A. Lavendel

Abstract

This article focuses on how on-line searching via computer operators has revolutionized information retrieval. Previously, the paper chase, which involves a staggering amount of data and information, had overwhelmed both engineers and students alike. However, by dialing a network number, accessing information can be done quickly and cheaply, especially if you compare it with the hidden cost of time-consuming manual searches in libraries, and can be done far from the data base itself. The bulk of the world's abstract and index literature, formerly available only through endless printed volumes, is now available in machine-readable form. Currently, there are over 21 data bases for engineers, but they often require the assistance of an experienced operator. Once a particular data base has been selected, a comprehensive index, which utilizes a limitless array of descriptors or key words, enables the searchers to retrieve a very in-depth listing of journals, cases, books, etc. on that particular subject. After reviewing the abstracts, the searchers can then choose what information is to be printed out.

Lavendel, G. A., "The Computer in Research: A Real-Time Partner," IEEE Spectrum, pp. 38-40, December 1978.

EVERYTHING YOU ALWAYS WANTED TO KNOW MAY SOON BE ON-LINE

Walter Kiechel III

Abstract

As spies and touts have always known, information is a salable commodity. And just as satellites orbiting in space are transforming the business of espionage, so there is also a revolution taking place in the way other information is collected, packaged and distributed. For this we have the computer to thank. A new industry is growing up around on-line "data bases," huge banks of information that is processed, stored, and delivered electronically. What the new businesses provide is not so much additional information--most of it has been lying around in printed form for a long time--but a radical improvement in the ease with which information can be retrieved, a promise that the curious can find what they need to know in just a matter of seconds.

This article explores the growing business of information services, listing ten on-line services and their costs. Additionally, the role of the U.S. government as a vendor in the data-base industry is discussed.

Kiechel III, Walter, "Everything You Always Wanted to Know May Soon Be On-Line," Fortune, pp. 226-228, 233, 240, May 5, 1980.

A.2.2. Chapter 5. Distribution

ORGANIZE FOR TECHNOLOGY TRANSFER

Richard N. Foster

Abstract

Application of a technology to some product or process other than that originally intended is common in U.S. industry. But few companies have organized their technology transfer efforts systematically enough for commercial purposes, the author of this article asserts. And many that try it start with the technology and seek applications for it, whereas they should begin with the first buyer of the envisioned product. The author goes step by step through the process, discussing along the way the data banks that can be explored (many of them government sponsored) and estimating the human and financial investment involved.

The author details five steps involved in the technology transfer process. These five steps are: (1) Creating a resource base; (2) Defining needs and markets; (3) Making a match; (4) Evaluating and selecting; (5) Adapting the technology. An example of the process is given. The author also details how to organize and the cost factors involved in technology transfer. The article concludes with a sample problem statement.

Foster, Richard N., "Organize for Technology Transfer," Harvard Business Review, pp. 110-120, November-December 1971.

TECHNOLOGICAL COOPERATION FOR WORLD SURVIVAL

William C. Norris

Abstract

The wheel is being reinvented every day throughout the industrial world. Yet vast amounts of existing technologies are under-utilized. There is an enormous waste of technical resources. Therefore, it is needed to minimize unproductive duplication and to share the resulting benefits through worldwide pooling of technological effort at all levels.

Major hindrances: (1) one of the largest untapped resources of the world is the wealth of information and technology buried in libraries and laboratories of businesses, government, research institutions, academic institutions and individual inventors. But this asset is not being used effectively because its transfer is so inefficient. (2) Efficient transfer of technology demands human communication, questioning and explanation. (3) There is a need for increased cooperation.

Norris, William C., "Technological Cooperation for World Survival," Computers and People, vol. 26, pp. 9-12, May 1977.

WORD OF MOUTH PROCESSES IN THE DIFFUSION OF A MAJOR TECHNOLOGICAL INNOVATION

John A. Czepiel

Abstract

This article presents a microanalytic study of the use of word-of-mouth among decision makers in competitive firms in the diffusion of a major technological innovation. The author studied 32 firms in the steel industry and followed the diffusion of the continuous casting process, a major technological innovation. Interviews were conducted with more than 60 people in these firms who are responsible for innovation. The findings showed that there was a network connecting the firms; industry members have regular opinion/advice relationships with 2-3 other firms in the industry. The small steel mills initiated conversations with the "Big Steel firms" more often than the reverse, supporting the contention that lower status individuals initiate more with high status individuals.

The study data showed that the frequency of use of the informal channels among decision-makers was about five times a month. Another hypothesis supported involved early adoptors of innovations exhibiting greater opinion leadership than late adoptors. The most significant finding of the study was the discovery of a functioning informal community linking together the firms.

Czepiel, John A., "Word of Mouth Processes in the Diffusion of a Major Technological Innovation," Journal of Marketing Research, vol. XI, pp. 172-179, May 1974.

MEASURING THE EFFECTIVENESS OF A RAPID RESPONSE TECHNOLOGY TRANSFER PROGRAM

Eugene H. Early

Abstract

This paper describes a method that has been developed to measure the effectiveness of a technology transfer program. The method was used on an on-going Navy program and showed that benefits to Navy users amounted to almost $3 for every program dollar spent. The method was developed by two Civil Engineering Corps officers, LCDR Jack Hendrickson and LT Bill Fisher, and documented as a Naval Postgraduate School report in December 1974. It was their thesis for the degree of Master of Science in Management.

The technology transfer program described in this paper was funded by the Naval Facilities Engineering Command (NAVFAC) and executed by the Navy's Civil Engineering Laboratory (CEL) with the purpose of providing rapid response service on short term requests for technological assistance from Navy shore activities. The program is coordinated by CEL's Facilities Engineering Support Office (FESO).

Early, Eugene H., "Measuring the Effectiveness of a Rapid Response Technology Transfer Program," pp. 61-80, in Technology Transfer in Research and Development, J. A. Jolly and J. W. Creighton (ed), Naval Postgraduate School, Monterey, California, 1975.

WORKING GROUP REPORTS--TRANSPORTATION TECHNOLOGY

J. Grey and M. Newman

Abstract

This was the last in a series of six reports regarding the transfer of technology from NASA to the public sector. Transportation technology involves a wide range of topics such as air transportation, maritime transportation, urban mass transit, federal highway programs, etc. It was recommended that the federal government should increase its efforts to promote technology transfer by actively generating, stimulating, encouraging and backing it. Although the transfer of technology from the aerospace field to the commercial aviation industry has been very successful, transfer to rail, urban, and maritime transportation and transportation-related areas is unstructured. To set up a working transfer system in these areas, communication barriers, regulatory restraints, political restraints, the 'not invented here' syndrome and many other problems must be overcome.

Grey, J., and Newman, M., "Working Group Reports--Transportation Technology," Aerospace Technology Transfer to the Public Sector, pp. 49-54, June 1978.

ACTION ORIENTED STRATEGIC PLANNING: THE CONCEPTS OF INFRASTRUCTURE AND FUNCTIONAL DOMAINS

Samuel N. Bar-Zakay

Abstract

The problem is how to translate limited and uncertain knowledge about the future environment into operational strategic policy decisions. Because the strategic policy decisions must be made with a long time perspective in mind (10 to 20 years), planners tend to formulate strategies which are overly broad. A solution to the broad and uncertain approach is to employ a system that relies upon the use of the infrastructure. When the infrastructure is divided into permanent and complete societal functions, then specific opportunities can be presented to the organization. Examples of functional domains that may be relevant to strategic long-range planning are: industrial capabilities, pieces of legislation, regulation and training. Our knowledge about evolving world trends is usually available in functional terminology (i.e., the evolving "information society", the "leisure society", the "energy crisis", and the "food crisis", etc.). Knowledge about the future behavior of the Functional Domains may enable organizations such as governments and/or corporations, to create the required infrastructure for capitalizing on possible opportunities.

Bar-Zakay, Samuel N., "Action Oriented Strategic Planning: The Concepts of Infrastructure and Functional Domains," Journal of Technology Transfer, 2(2), pp. 35-42, 1978.

A.2.3. Chapter 6. Organization

MANAGEMENT EDUCATION COMPANY CLIMATE AND INNOVATION

H. Baugartel, L. E. Dunn, and G. I. Sullivan

Abstract

This article focuses on the findings of evaluation research programs designed to study the way three interacting factors affect the take-home benefits resulting from participation in advanced management development programs. It basically talks about what is necessary in management education, which entails a program to increase take-home benefits. If a management education center wants to increase the take-home benefits of its programs then the program must deal with specific problems faced by the manager at the time. It should develop skills that are analytical and problem solving and should teach interpersonnel skills. Most importantly, it should provide a personal growth experience. If a company wants to increase the benefits to be gained from sending managers to advanced management programs then it should undertake activities which will move its climate in the direction conducive to innovative behavior.

Baugartel, H., Dunn, L. E., and Sullivan, G. I., "Management Education Company Climate and Innovation," Journal of General Management, pp. 17-26, 1977.

A STUDY OF THE TECHNOLOGY TRANSFER CAPABILITY OF ELEVEN ORGANIZATIONS

J. A. Jolly

Abstract

This paper reports on research conducted to measure the differences in performance between organizations that accept technology movement and utilization simply as a diffusion process as contrasted to organizations that make a purposive, conscious effort to communicate and utilize knowledge. A distinction is made between the diffusion process and the technology transfer process. The Creighton, Jolly and Denning model of technology transfer is reviewed briefly, and the analysis technique is explained. The author concludes that, although this research is still in the very early stages, a difference was found between the organizations and that it may be possible to identify (using the technique) organizations that are high performers in terms of technology transfer and those which are low performers.

Jolly, J. A., "A Study of the Technology Transfer Capability of Eleven Organizations," pp. 81-91, in Technology Transfer in Research and Development, J. A. Jolly and J. W. Creighton (ed), Naval Postgraduate School, Monterey, Calfiornia, 1975.

TWO MODELS OF CORPORATION AND INTERNATIONAL TRANSFER OF TECHNOLOGY

Y. Tsurumi

Abstract

Korea and Brazil are examples of where subsidiaries of multinational corporations have absorbed production technologies and developed export markets, especially in the U.S. and Japan. Through imitation and adaptation, Korean and Brazilian firms learned not only production know-how, but also institutional skills, such as management skills, from their business partners. Similarly, the abilities of China and other Asian countries to absorb requisite production technologies are tied to their abilities to absorb the institutional technologies. Given the significance of interactions between process-related technology, and institutional technology, we can deduce that differences in corporate culture and management styles would affect the effectiveness of technology transfer by Japanese firms compared with American ones to developing countries such as those in Asia. Model A firms (American) are characterized by: a concentration of decision-making in the upper echelons, with a short time horizon in the lower echelons; assumption of interchangeable, transferrable skills from firm to firm in workers; and an assumption of pay being the primary motivation for performance. Model J (Japanese) firms are characterized by:

decision-making carried out in middle as well as upper echelons; the view that workers are not productive until they have learned the implicit rules on personal relationship and culture in the new firm; and the assumption of psychological motivation in performance. Model A and J firms would have to build different management-employee relations in foreign environments in order to transplant their technology.

Tsurumi, Y., "Two Models of Corporation and International Transfer of Technology," Columbia Journal of World Business, pp. 43-50, Summer, 1979.

A.2.4. Chapter 7. Project Selection

MANAGEMENT OF TECHNOLOGY TRANSFER IN AN ADVANCED PROJECT--THE CASE OF SURVEYOR

W. E. Giberson

Abstract

This paper uses a specific advanced project, which is the Surveyor, as a basis for presenting a number of problems in technology transfer and methods used to solve the problems. The paper emphasizes the importance of mission orientation to transfer and outlines the several organizational approaches that were tried before assigning full-time project groups within the discipline departments. Several examples of planning problems are followed by description of the organizational methods developed to deal with them. These include working residences, independent evaluation of prototypes and analysis by the user in parallel with the provider, design reviews, failure-mode analysis, and problem-failure reporting.

Giberson, W. E., "Management of Technology Transfer in an Advanced Project--The Case of Surveyor," IEEE Transactions on Engineering Management, vol. EM 16, no. 3, pp. 125-129, August 1969.

PROJECT SELECTION METHODS THAT PICK WINNERS

Albert Paolini, Jr. and Milton A. Glaser

Abstract

The authors discuss how cost/benefit ratio methods, mathematical programming and innovation potential methods can be used in project selection. Examples of each of these methods is given. Emphasis is given to the simple scoring technique of the innovation potential method.

Paolini, Albert, Jr., and Glaser, Milton A., "Project Selection Methods that Pick Winners," Research Management, v. XX, no. 3, pp. 26-29, May 1977.

AN EVALUATION SYSTEM FOR PROJECT SELECTION

Martin J. Cooper

Abstract

A common language developed by the author for use by scientists and management suggests construction of an algorithm and value scale to aid in reaching R&D project decisions.

Cooper, Martin J., "An Evaluation System for Project Selection," Research Management, v. XXI, no. 4, pp. 29-33, July 1978.

FACTORS INFLUENCING INNOVATION SUCCESS AT THE PROJECT LEVEL

A. H. Rubenstein, A. K. Chakrabarti, R. D. O'Keefe,
W. E. Souder, and H. C. Young

Abstract

This article identifies factors encountered in the innovation process in organizations at the project level and analyzes their impact on the research and development process. Factors were grouped into six categories: 1) Impetus for Innovation, 2) Project Decisions and Criteria, 3) Project Structure and Process, 4) Organization Structure and Process, 5) Outcomes, and 6) Others. The dependent variables which the authors looked at were the degree of technical success and the degree of overall project success. Although the technical solution of the problem is the major responsibility of R&D and related activities, it is not the criterion which measures the value of the project outcome. Results indicated R&D projects succeed for a number of reasons; there is not one set of factors that governs project success or failure. It was emphasized that the role of a product champion is a necessary condition for a project's success. The authors recommended that there is a need for improved communications among company R&D functions and a need for improved data gathering methods.

Rubenstein, A. H., and others, "Factors Influencing Innovation Success at the Project Level," Research Management, vol. 19, no. 3, pp. 15-20, May 1976.

THE MANAGEMENT OF INNOVATION

D. B. Hertz

Abstract

Innovation in industry is no longer just something nice to have; it has become a matter of survival. Studies show that a key factor in the firm's success with innovation is the involvement of top management. When management does not become involved in the direction its researchers take, it is abdicating its responsibility and could be placing the future of the firm in jeopardy. In fact, some findings show that up to one-half the good research ideas developed in the chemical, electronics and drug industries were originally suggested by top management. It is important that there be good channels of communication between the research people and top management. In this regard, direct, personal relationships are preferred over committee structures in involving management with research. The shift to the matrix approach in organization has also involved researchers in the entire process of getting the innovation manufactured and out for sale. The key to successful management of innovation appears to be good communication.

Hertz, D. B., "The Management of Innovation," Management Review, v. 54, no. 4, pp. 49-52, April 1965. Condensed from an address before the American Association for the Advancement of Science.

IMPLEMENTING CHANGE: TEN QUESTIONS TO ASK

John F. Wetjen

Abstract

Implementing change whether in projects or processes has broad implications in its total impact. In evaluating change, most approaches involve a single methodology, such as risk analysis or return on investment. The total impact that any proposed change may have, can be better evaluated by asking and answering these ten questions: 1. Will the change result in a better product or method? 2. What will be the impact on existing systems? 3. What will be the total cost of the change? 4. What will be the total savings of the change? 5. How does the change fit in with future plans? 6. Is the change adaptable elsewhere, and at what cost? 7. Does the change allow for volume fluctuations? 8. Are there social, economic and ecological implications to the proposed change? 9. If the change were not made, what would happen? 10. Why is the change being endorsed, and why wasn't it implemented earlier?

Wetjen, John F., "Implementing Change: Ten Questions to Ask," Management Review, v. 61, no. 11, pp. 46-48, November 1972. Condensed from Infosystems, August 1972.

PLANNING--KEY TO RESEARCH SUCCESS

R. Stolz

Abstract

Stolz emphasizes that sound management is necessary to make successful research possible, and that planning is required to avoid failure and to reduce costs. Research objectives must be tied to overall company objectives. Objectives must specify both the action which is required and clarify management intentions for expansion into new fields. Also management must be aware of the difficulties in translating business objectives into laboratory objectives. Another problem is that management often emphasizes tangible, short-range results rather than the less tangible long-range accomplishments. This results in the postponing of longer-range research studies which may be of value to the company. Stolz discusses two necessary phases in the planning process. Programming, which develops specific research objectives and guidelines are necessary. Specific criteria must be established for selecting projects and setting project priorities, for deciding whether the final selection is to be made by research or by top management, and for initiating procedures for the review of research projects.

Stolz, R., "Planning--Key to Research Success," Harvard Business Review (March-April 1960), pp. 82-88.

A.2.5. Chapter 8. Capacity of Receiver

A PROBLEM-SOLVING PACKAGE FOR DISSEMINATION AND UTILIZATION OF KNOWLEDGE

D. A. Lingwood

Abstract

The paper outlines a process of problem-solving in the area of the Havelock D&U model. It proposes a system to develop an open participative method of learning about D&U activities, and gives suggestions on methods designed to turn an introspective system into more creative channels. The process works through a series of six steps. The model emphasizes the processes and functions involved in the production and utilization of scientific knowledge rather than a model of structures. The steps involve group learning activities and stress group participation in order for the learning of the processes to be effective. The result desired by the end of the six steps is that the people involved in the sessions will be able to see new ways of using technologies, new ways of getting things done, and new ways of approaching systems.

Lingwood, D. A., "A Problem-Solving Package for Dissemination and Utilization of Knowledge," paper prepared for University of Michigan, 1973.

THE ADMINISTRATIVE EXPERIMENT: PLANNED INNOVATION AND EVALUATION

J. Anderson

Abstract

The purpose of this paper is to describe a set of activities which encourages both creativity in managerial problem-solving and systematic assessment of results. Examples from industry, community groups, service institutions, and education illustrate the activities. Cultivation of the skills involved in the administrative experiment will facilitate the advancement of the art of management. Thus, the administrative experiment is a set of procedures which, if followed routinely, enable a manager to learn from his experiences. The learning is made possible by the procedures' insistence upon comparisons to determine what happens and why when innovations are introduced in organizations. As more administrative experiments are conducted and reported in their entirety, managers' enlightenment will be shared and, hence, the art advanced.

Anderson, J., "The Administrative Experiment: Planned Innovation and Evaluation," IEEE Transactions on Engineering Management, vol. EM 21, no. 2, pp. 72-76, May 1974.

FUNCTIONS OF IGNORANCE IN INTRODUCING AUTOMATION

Bernard Karsh and Jack Siegman

Abstract

This paper focuses on the changes that occur in the accounting section of a large civil service bureau employing over 2,000 when an electronic digital computer system is installed.

It was found the keypunchers were greatly affected by the change in terms of their work, necessitating closer supervision. The keypunchers saw the new system as irrational since it made them feel useless and inferior. From the point of view of management, the increased rigid standardization and close supervision maximized the goals of organizational authority, though. Therefore, uncertainty and ignorance about application of work procedures decreased the keypunchers' confidence in their supervisor's knowledge, and the keypunchers increased the frequency of consultations among themselves.

The authors conclude that when knowledge is the basis for the existence of an occupation, the creation of boundary limits function to separate and keep ignorant those who are seen as actual or potential threats to the exclusivity of that knowledge. The dependence of others serves as a basis

of power, and the boundary mechanisms develop to protect this dependence.

Karsh, Bernard, and Siegman, Jack, "Functions of Ignorance in Introducing Automation," Social Problems, vol. 12, no. 2, pp. 141-150, Fall 1964.

THE EFFECTS OF TECHNOLOGICAL CHANGE

S. J. Boulier

Abstract

New changes in technology have put a burden on public relations people to possess or develop the "skill" of technological understanding in some depth. Equally important is the fact that technology is increasingly changing the way public relations people do their work. Applications of technology help them do a better, more effective job.

Another effect of technology in the PR field can be seen in the area of media change. Even AT&T has seen the addition of television writers, producers and technicians to their in-house skills in recent years.

The public relations office is now making use of some of the advantages of computer technology. Putlic relations personnel, it is stressed, need to help adapt this technology with programmers to provide successful public relations administration in the future. If personnel can adapt to meet the changes necessary to technological use, the payoff will be greater effectiveness for public relations.

Voulier, S. J., "The Effects of Technological Change," Public Relations Quarterly, vol. 21, pp. 16-17, Summer 1976.

TECHNOLOGY TRANSFER--CAPACITY BUILDING

James A. Jolly

Abstract

This paper presents an analysis of technology transfer that considers the fact that the word "innovation" is a noun and is also a verb. The verb concept is expanded and developed. A third concept of technology transfer, capacity building, is then introduced. A paradigm or check list of micro factors helpful in capacity building is given.

Jolly, James A., "Technology Transfer--Capacity Building," pp. 75-83 in Creighton, J. W., and Jolly, J. A. (ed), Technology Transfer: Research Utilization and User Stimulation, Naval Postgraduate School, Monterey, California, 1980.

FACTORS FOR SUCCESS IN INDUSTRIAL INNOVATION

Roy Rothwell

Abstract

Much of the study of the innovation process has been centered around specific innovation sub-processes and very little has been done in considering the integration of these sub-processes into a total process of innovation. One means of considering the total process is through analysis of actual innovation attempts. A number of such studies have been undertaken which were concerned with successful innovations. Each study has yielded a generalized list of empirically determined characteristics of successful innovations. However, some of these characteristics are likely to be common to all innovations, including failures. Project SAPPHO (Scientific Activity Predictory from Patterns with Heuristic Origins), using the technique of paired comparisons between paired innovations, one being successful the other unsuccessful, sought to determine patterns of difference between the two. A total of forty-one variables were found to be statistically significant in systematically differentiating between success and failure of innovations in the chemical and electronic instruments industries. These variables can be grouped within a number of areas of competence given under the general headings of: strength of and characteristics of management, understanding of user needs, marketing performance,

efficiency of development and communications. One of the most important findings was that successful innovators outperformed failures in all the areas of competence. This supports the multi-factor explanation for successful innovation.

Rothwell, Roy, "Factors for Success in Industrial Innovation," Journal of General Management, vol. 2, no. 2, pp. 57-65, Winter 1975.

THE CHARACTERISTICS OF TECHNICALLY PROGRESSIVE FIRMS

C. F. Carter and B. R. Williams

Abstract

This article explains in greater detail the authors' analysis of the relation between technical progressiveness and certain other characteristics of firms in their book Industry and Technical Progress (Oxford University Press, 1957, pp. 177-184). They divided firms into three categories: those in the forefront of discovery in applied science and technology, those quite uninterested in examining alternatives to traditional methods, and a large middle group--neither outstanding leaders in technology nor wholly uninterested in it. They used 29 characteristics for rating the progressiveness of firms, and use a rating scale of 0-8. In addition, they weighted the characteristics as to their importance in each industry. 24 of the characteristics proved to have a prima facie relation to technical progressiveness. Some of the characteristics used were: (1) high quality of incoming communication; (2) a readiness to look outside the firm; (3) a willingness to share knowledge, (4) a willingness to take new knowledge on license and to enter joint ventures; (5) effective internal communication and coordination; (6) a deliberate survey of potential ideas; (7) a consciousness of costs and profits in the research and development departments; (8) identifying the

outcome of investment decisions; (9) use of management techniques; (10) high status of science and technology in the firm; (11) use of scientists and technologists on the Board of Directors; (12) a high rate of expansion; (13) an effective selling policy; (14) good quality in intermediate management; and (15) high quality of chief executives.

Carter, C. F., and Williams, B. R., "The Characteristics of Technically Progressive Firms," Journal of Industrial Economics, pp. 87-104, March 1959.

A.2.6. Chapter 9. Linker Role

THE LINKER ROLE IN INNOVATION

Dr. J. W. Creighton and Dr. J. A. Jolly

Abstract

A brief description of the author's work in identifying the essential elements contributing to the flow change of causing information is provided. The linking function is described as one of these elements, and guidance is given as to how the linker type of individual performs, how he/she perceives the role, and the rewards expected. The paper attempts to provide further understanding of the linker role in an organization and indicate how the linker characteristics might cause others to respond. Finally, it attempts to integrate the linker element with other identified information flow elements to show how interactions between elements occur.

Creighton, Dr. J. W., and Jolly, Dr. J. A., "The Linker Role in Innovation," presented at the "Conference on Learning Technology for the 80's," February 11-12, 1981, Orlando, Florida.

THE TECHNOLOGICAL GATEKEEPER: EVIDENCE IN THREE INDUSTRIES

James William Brown

Abstract

Previous studies have developed the concept of the "technological gatekeeper" as one who is integral in the diffusion of scientific and technical information from the environment into the R&D firm. Gatekeepers have been found in firms operating in environments with rapidly changing technology. Using data from six firms in three industries, the present study found the gatekeeper phenomenon extends to firms with less rapidly changing environments. Thus, the gatekeeper construct becomes important to any firm with a R&D mission. Additionally, many of the sociometric and demographic characteristics of gatekeepers were validated in new research settings.

Brown, James William, "The Technological Gatekeeper: Evidence in Three Industries," Journal of Technology Transfer, 3(2), pp. 23-36, 1979.

MANAGING COMMUNICATION NETWORKS IN R & D LABORATORIES

Michael L. Tushman

Abstract

Even though the process of developing and introducing technological innovation is central to industrial firms, the innovation process is relatively costly and inefficient. Recent research indicates that organizational factors (i.e., non-technical factors) are often the most critical barriers to effective innovation. In this article Tushman focuses on the mechanisms by which research and development laboratories acquire and process information.

A contingency model for managing R&D communication is developed based upon the nature of the work being conducted. This communication model recognizes the following three-stage process. First, the amount and pattern of communication within the project must be able to attend to the information processing requirements of the particular task and task environment. Second, the project must be linked to interdependent areas within the firm and to those areas that can provide technical feedback and support. Third, the project must be linked to external sources of information through direct contact and/or boundary-spanning individuals. Specific diagnostic questions are elaborated which are designed to encourage management to actively think about and manage the communication network for innovation. Communication

patterns must be developed to meet the information processing demands of the work involved in particular projects.

Tushman, Michael L., "Managing Communication Networks in R&D Laboratories," Sloan Management Review, v. 20 (Winter 1979), pp. 37-49.

PLANNING FOR INNOVATION THROUGH DISSEMINATION AND UTILIZATION OF KNOWLEDGE

R. G. Havelock and others

Abstract

Havelock feels that any detailed consideration of the dissemination of knowledge must sooner or later focus on the question of linking roles. Havelock then presents in his paper, a very comprehensive view of the linking role. He discusses a typology of linking roles whose variety includes the conveyor, consultant, trainer, leader, innovator, the user as a linker, etc. Together, all these functions are needed to establish and maintain linkage between knowledge sources and users. Havelock then discussed the linking role in its institutional context. There are three institutional questions of highest relevance to the topic of linking agent: 1) What sort of institutional barriers, both in the resource system and in the client system most frequently affect knowledge dissemination and utilization? 2) What kind of institutions are most effective for fathering linking roles? and 3) What kinds of institutions serve as linkers? Havelock then addressed the endemic problems of overload and marginality in the linking roles. Overload occurs when the linkers have too much to do in any of their three key processes.

Marginality is more complex and may well be inherent in the linking role for strategic reasons.

Havelock, R. G., and others, Planning for Innovation Through Dissemination and Utilization of Knowledge, pp. 7-1 - 7-40, ISR, University of Michigan, 1971.

THE ROLE OF COMMUNICATIONS IN TECHNOLOGICAL INNOVATION

R. Rothwell and A. B. Robertson

Abstract

Technological innovation can be represented as a complex net of communication paths linking the various stages of the innovation process. This paper briefly reviews some of the more significant empirical works which have related innovative success to communications, describes the sources of ideas leading to and utilized during innovation, considers the patterns of information flow found to occur during innovation and discusses the role of individuals in technology transfer. Good communications, then, are highly important to successful technological innovation; they are, it seems, a key factor in determining innovative success. The importance of individuals as agents of technology transfer cannot be overstressed and the implications to management of identifying and encouraging 'technological gatekeepers' are obvious. It is likely that one of the prime functions of the various 'key individuals' who have been identified as of importance to successful innovation is that of coordinator; he is the key link in the chain of communications and he probably will also be a technological gatekeeper.

Rothwell, R., and Robertson, A. B., "The Role of Communications in Technological Innovation," Research Policy, pp. 205-224, 1973.

THE INTERNATIONAL GATEKEEPER

T. J. Allen, J. M. Piepmeier, and S. Cooney

Abstract

Allen addresses the problem of how to select and apply effective pieces of technology from the vast reservoir of technological information which exists in the world. Like small countries, no single organization can be technologically self-sufficient; it must always import relevant technology, and its effectiveness in doing this may be a key factor in the organization's success. Technological gatekeepers are the one information source whose use has consistently shown a positive correlation with technical performance. These colleagues, highly regarded as internal consultants, are shown to make significantly greater use than their associates of the professional and scientific journals and to maintain ongoing informal contact with many colleagues in other laboratories. The data strongly supports the gatekeeper hypothesis. In addition to his communication activity, the international gatekeeper displays somewhat greater technical competence than his nongatekeeper colleagues. Allen concludes his article by stating that given the importance and existence of international gatekeepers, steps must be taken to develop people into this role.

Allen, T. J., Piepmeier, J. M., and Cooney, S., "The International Gatekeeper," Technology Review, v. 73, no. 5, pp. 3-9, March 1971.

KNOWLEDGE LINKERS AND THE FLOW OF EDUCATIONAL INFORMATION

R. S. Farr

Abstract

Farr states that if knowledge is to have much value, it must at some time move from the minds of the individuals responsible for its existence to the minds of those responsible for its utilization. An intermediary known as a linker, greatly enhances this movement. The linker selects several channels such as periodicals, conferences, laboratories. However, extensive studies have shown that informal, interpersonal channels of communication are by far the most effective way to reach an audience. That is, according to Farr, word gets around best when people talk to each other. It is the interpersonal network of communication therefore, that the linker must seek to activate. The role of the linker, which is also labeled detail man, information retrieval specialist, consultant, or change agent, is a demanding task requiring specialties that are not yet completely understood. Two major problems facing the knowledge linker are overload and marginality. Overload refers to the great work demand made upon the linker in each of his functions. Marginality refers to the linker's position as a go-between. Farr illustrates an adoption process aimed at establishing permanent

linking institutions. Finally, Farr describes the importance of gatekeepers, who often function as secondary linkers.

Farr, R. S., Knowledge Linkers and the Flow of Educational Information, September 1969, pp. 1-14. An Occasional Paper from ERIC at Stanford.

THE LINKER'S CONTRIBUTION TO TECHNOLOGY TRANSFER

Peter George, James A. Jolly, and John W. Creighton

Abstract

The role of an individual known as a 'linker' is examined and the similarities between his role and those of 'gatekeeper', 'opinion leader', and 'innovator' are discussed in detail. Not only are the similarities among these roles pointed out but also the unique characteristics of the 'linker' are clarified. A Linker Model for Technology Transfer is presented showing the value of a 'linker' to the parent and users organizations. Managerial endeavors to understand and promote technology transfer can be facilitated by the in-depth research presented.

George, Peter, Jolly, James A., and Creighton, John W., "The Linkers Contribution to Technology Transfer," Journal of Technology Transfer, 3(1), pp. 51-61, 1978.

A.2.7. Chapter 10. Credibility of Source and Channel

COMMUNICATOR CREDIBILITY AND COMMUNICATION DISCREPANCY AS DETERMINANTS OF OPINION CHANGE

E. Aronson, J. A. Turner, and J. M. Carlsmith

Abstract

An experiment to show that opinion change is a function of a specific complex interaction between credibility of the communicator and the discrepancy of the communication. The experiment was designed to investigate the conditions under which changing one's opinion and derogating the communicator are chosen as alternative methods of reducing the dissonance which is created when an individual is exposed to an opinion which is discrepant from his own. Findings included: (1) Highly credible communicators were more successful in inducing opinion change than the mildly credible communicator at every point of discrepancy; (2) In the high credibility condition opinion change increased with degree of discrepancy; (3) The mildly credible communicator is not only less able to induce opinion change, but actually induces less change with a large discrepancy than with a moderate discrepancy. Two conclusions were drawn by the researchers: (1) As the communicator is made less credible, more derogation is used to reduce dissonance, resulting in less opinion change; and (2) With mild credibility,

derogation replaces opinion change earlier as the major method of reducing dissonance.

Aronson, E., Turner, J. A., and Carlsmith, J. M., "Communicator Credibility and Communication Discrepancy as Determinants of Opinion Change," Journal of Abnormal and Social Psychology, Vol. 67, No. 1, pp. 31-36, 1963.

COMMITMENT OF AUDIENCE AND LEGITIMACY AND ATTITUDINAL STANCE OF COMMUNICATOR

C. A. Kiesler, M. S. Pallak, III, and R. Archer

Abstract

A laboratory experiment was conducted in which the following factors were varied: one's prior commitment to consonant behavior and the legitimacy and attitudinal stance (agree-disagree) of a communicator. A variety of measures were taken to define subject's perceptions of legitimate and illegitimate communicators. Legitimacy tended not to affect uncommitted subjects. Committed subjects responded positively to the legitimate communicator and negatively (boomerang) to the illegitimate speaker, regarding attitude change, behavioral measures, and information-seeking, regardless of the attitudinal stance of the communicator.

The authors also found that "the legitimate communicator was perceived to be more knowledgeable, more qualified, more persuasive, and more competent than the illegitimate communicator." They conclude that "the power of the legitimacy manipulation is noteworthy. This manipulation affected subject's perceptions of the speaker not only in areas relating specifically to expertise, but also the speaker's justification in speaking out."

Kiesler, C. A., Pallak, M. S., III, and Archer, R., "Commitment of Audience, and Legitimacy and Attitudinal Stance of Communicator: A Test of the 'Woodwork' Hypothesis," Psychological Reports, 1974, 35, pp. 1035-1048.

CONDITIONS WHICH NURTURE THE APPLICATION OF FOREST RECREATION RESEARCH RESULTS

B. L. Driver and Niels Elers Koch

Abstract

Research is undertaken to accomplish one or more of three purposes: (1) to produce a better basis for decision-making outside the research community; (2) to contribute to a body of knowledge so that additional research can build on that knowledge; and (3) to contribute to a body of knowledge for the intrinsic intellectual benefits realized from greater knowledge. Research addressing the first purpose is commonly called applied research, while research addressing the second and third purposes is basic research.

Although the distinction between applied and basic research is not always clear, most forest recreation research is applied research, because it usually is conducted to help forest resource policy-makers and managers make better decisions.

This paper addresses a problem experienced by many forest recreation researchers. Posed as a question, that problem is as follows: How can the results of applied forest recreation research be transferred into management practices quickly and successfully? The paper attempts to help answer that question by describing eleven conditions which can help assure the transfer of research results, several of which

emphasize the need for credibility on the part of the researcher, the user, or both.

Driver, B. L., and Koch, Niels Elers, "Conditions which Nurture the Application of Forest Recreation Research Results," Journal of Technology Transfer, 6(1), pp. 33-40, 1981.

INITIAL ATTITUDE, SOURCE CREDIBILITY, AND INVOLVEMENT AS FACTORS IN PERSUASION

Elliott McGinnies

Abstract

McGinnies' study is concerned with the persuasive effects of varying source credibility and how this relationship is influenced by the initial attitude and involvement of the receiver. Japanese university students (the subjects) were divided by sex, by moderate or strong initial attitude, and by high and low involvement. A written communication was utilized and attributed to two different authors considered to be of high or low credibility. The results found that a high credible source was more effective in changing beliefs of those subjects who were of extreme initial attitudes. However, there appeared to be no difference in the effectiveness of a high or low credibility source in persuading the moderately involved subjects. The study concludes that subjects that are not strongly involved stand a higher probability of being persuaded and that the probability of persuasive failure is highest when a receiver's opinion is strongly held and is very different from the proposed position.

McGinnies, Elliott, "Initial Attitude, Source Credibility, and Involvement as Factors in Persuasion," Journal of Experimental Social Psychology, pp. 284-296, 1973.

THE CONTRIBUTION OF STUDIES OF SOURCE CREDIBILITY TO A THEORY OF INTERPERSONAL TRUST IN THE COMMUNICATION PROCESS

Kim Griffin

Abstract

This article discusses interpersonal trust in the communication process which is defined as reliance upon the communication of another person in order to achieve a desired but uncertain objective in a risky situation. A theory of the dimensions of interpersonal trust in communication is presented. Experimental studies of ethos and factor-analytic studies of source credibility support the hypothesis that interpersonal trust is based upon a listener's perceptions of a speaker's expertness, reliability, intentions, dynamism, personal attractiveness and the majority opinion of the listener's associates.

Griffin, Kim, "The Contribution of Studies of Source Credibility to a Theory of Interpersonal Trust in the Communication Process," Psychological Bulletin, Vol. 68, No. 2, pp. 104-120, 1967.

THE INFLUENCE OF SOURCE CREDITABILITY ON COMMUNICATION EFFECTIVENESS

C. I. Hovland and W. Weis

Abstract

The study is a part of a coordinated research project on factors influencing changes in attitudes and opinions, which was then being conducted at Yale University. It focuses on how communications presented by different communicators differs and the relative effects on opinions subsequently measured without explicit reference to the position taken by the communicator. The hypothesis deals with the trust factor involved in communications. The experiment described was designed to test differences in the retention, as well as the acquisition, of identical communications when presented by trustworthy and by untrustworthy sources. Results point out that the content of the communication is learned and forgotten to the same extent regardless of the communicator. But the extent of opinion change is influenced by both learning and acceptance, and the effect of an untrustworthy communicator is to interfere with the acceptance of the material.

Hovland, C. I., and Weis, W., "The Influence of Source Creditability on Communication Effectiveness," Public Opinion Quarterly, pp. 634-650, Winter 1952.

A.2.8. Chapter 11. Reward System

NEW APPROACHES FOR COMPENSATION OF INVENTORS

Willard Marcy

Abstract

This article presents some alternative methods that might provide the best reward to inventors. The author is vice president of patent programs of Research Corporation and chairman of the Committee on Patent Matters and Related Legislation, American Chemical Society. Marcy says that most authors look at the subject of compensation for the employed inventor, but he will examine it from the viewpoint of the public. The employer believes that any inventive discovery made by his employee belongs to him, the employer, without any doubt and in spite of extenuating circumstances. The employer believes that if he goes beyond the call of duty, he should receive a reward. The author discusses the Moss bill and the German law dealing with patents. He concludes that unless employers and employed inventors assume the responsibility of developing compensation acceptable to both sides, the threat of legislation will remain.

Marcy, Willard, "New Approaches for Compensation of Inventors," Research Management, pp. 25-28, March 1978.

HOW THE IBM AWARDS PROGRAM WORKS

W. J. Turner

Abstract

This article reviews the successful incentive program at IBM and how it recognizes both technical and nontechnical achievements. The author is a manager of research staff operations at International Business Machines Corporation. The incentive awards are independent of pay and other compensation. They also must be geared to the recognition of the individuals. There are five basic awards at the company and these are the Outstanding Innovation Award, the Research Division Outstanding Contribution Award, the Corporation Award, the Invention Achievement Award, and the Research Division Award. The Outstanding Innovation Award is presented to about 40 inventors a year with the amounts ranging from $2,500 to $10,000. The Research Division Outstanding Contribution Award is given to individuals in a division and is usually $2,500 to $10,000. The Corporate Award is given selectively with the amounts ranging from $10,000 to $50,000 and more. The Invention Achievement Award is a merit reward of $2,400 given when a researcher accumulates twelve points. The Research Division Award ranges from $75 to $1,500. The author says that in general the employees like the awards program.

Turner, W. J., "How the IBM Awards Program Works," Research Management, pp. 24-27, July 1979.

MAKING TECHNOLOGY TRANSFER HAPPEN

Joseph Gartner and Charles S. Naiman

Abstract

This article concerns the problems of transferring technology to work in all levels and how the inherent barriers must be eliminated and incentives introduced to stimulate the transfer process. The authors, Dr. Gartner who is research director and associate professor in the School of Management at Boston College and Dr. Naiman who is the director of laser metalworking at Avco Everett Research Laboratory, suggest that most of the transfer problems occur at the subsystem and elements levels. The subsystems are departments or divisions within a laboratory or company and the elements are the individuals in respective departments directly involved in the transfer process. Confusion within laboratories include the problem of ownership of an invention and whether or not a department will share in the income of the patent. Incentives for subsystems include new equipment and lessened penalties for exceeding budgets. Incentives for elements include bonus payments, stock plans, tuition allowance promotions, awards, and special recognition. The author summarizes the activities which should be performed at each stage of the transfer process.

Gartner, Joseph, and Naiman, Charles S., "Making Technology Transfer Happen," Research Management, pp. 34-38, May 1978.

TAILORING INCENTIVES FOR RESEARCHERS

Lawrence R. Jauch

Abstract

This article concludes that incentives are needed for researchers because there is an inordinately high incidence of turnover among scientists. Among the factors mentioned as reasons for changing jobs were different career directions, more interesting work, opportunity for advancement, and salary. A study concluded in 1970 found that losses in output occur whenever scientists change employers and there is also a substantial loss of investment. Another study found that lack of financial incentives was one of the three basic conditions that discouraged productivity in large scale corporate research laboratories. Among the types of incentives for scientists are merit salary increases, promotions within career ladder, stock options, profit sharing, rewards for suggestions, improved office space, increased technical or clerical assistance, increased challenge in job assignment, encouragement to publish, time off for professional meetings, greater freedom to come and go, better technical equipment, and participation in company seminars. The author discusses the effectiveness of these incentives.

Jauch, Lawrence R., "Tailoring Incentives for Researchers," Research Management, pp. 23-27, November 1976.

SCIENTISTS IN ORGANIZATIONS

D. Pelz and F. Andrews

Abstract

The authors have examined a number of things the organizations can do to reward achievement, falling into two broad categories: rewards intrinsic to the work itself (such as opportunity to use skills, to gain new knowledge, to deal with challenging problems, and to have freedom to follow up one's own ideas), and those extrinsic to the technical content (a good salary, higher administrative authority associated with top executives). The research director must give close attention to the whole system of rewards--both intrinsic and extrinsic. He must live with the paradox that extrinsic rewards cannot be relied on to motivate achievement, but that when achievement occurs, the extrinsic rewards should be consistent. And possibly the very provision of them will stimulate further achievement.

It is also believed that ambition for status is a shaky basis on which to spur achievement among staff members. But oddly, the actual provision of status rewards was definitely associated with achievement, even when we limited our attention to people at a single career level.

Pelz, D., and Andrews, F., Scientists in Organizations, pp. 112-139, The University of Michigan, 1976.

INDUSTRIAL RESEARCH INSTITUTE POSITION STATEMENT ON RECOGNITION AND REWARDS FOR INDUSTRIAL INNOVATION

Abstract

This short article presents the Industrial Research Institute's position on recognition and rewards for industrial innovation. They say that while the Federal government should establish policies which encourage innovation, fixing awards by law would be counterproductive. The IRI states that Europe and Japan are contributing a larger portion of world-wide research and development accomplishments, the government through excessive regulatory actions and burdensome tax policies has had a major adverse effect upon the rate of technological innovation in the United States, and major influences within industry itself are affecting our rate of innovation. To stimulate innovation the IRI believes that: all members of the innovation team must be financially rewarded by fair and equitable salaries, awards required by law will not increase the number of innovations and may be counterproductive, people in areas besides R&D may also deserve special consideration, patents not used by the companies should be sold or given to the inventors, and the Federal government should establish policies which encourage innovation and risk-taking.

Industrial Research Institute, "Industrial Research Institute Position Statement on Recognition and Rewards for Industrial Innovation," Research Management, pp. 39-40, July 1979.

RESEARCH: HOW REWARDS CAN BE MADE MORE EFFECTIVE BY PROPER STRUCTURING

Albert S. King

Abstract

This article is written by Albert S. King, who is an Associate Professor in the Department of Management at Northern Illinois University. He says that more satisfaction can be attained in employee groups by arranging incentives, evaluations, and rewards so that high levels can be achieved frequently, even if this means deferring those wonderful but rare rewards that might be even more fulfilling. To help make his point, the author uses an example from sailing that illustrates how the range-frequency theory explains the dividing line between satisfaction and dissatisfaction. The author concludes that there does appear to be differences in employee satisfactions with reward distributions that are skewed to the high or low end of the range of possible rewards. Planned changes in organizational reward programs would have greater chances of success if distributions contained some optimal frequency of rewards and some maximal figure to ensure managers a degree of predictability concerning the effects of reward influence. This suggests that high employee morale comes from a negatively skewed reward distribution.

King, Albert S., "Research: How Rewards Can Be Made More Effective by Proper Structuring," Compensation Review, January 1978, pp. 32-40.

PRODUCTIVITY FROM SCANLON-TYPE PLANS

A. J. Geare

Abstract

This article examines Scanlon Plans and how they incorporate some type of group incentive payment and encourage some worker participation in order to achieve the productivity improvements. The Scanlon Plan is a philosophy of union-management relations in which productivity gains are obtained as a result of plant or companywide participation and cooperation, encouraged by bonus payments. The author is a Lecturer in Industrial Relations at the University of Otago in Dunedin, New Zealand. The author covers an example which shows how the bonus can be distributed under various types of Scanlon Plans. Other topics covered include distribution of the bonus under the Rucker Variant, obtaining productivity improvements, results under the Scanlon Plan, and factors determined in the success of the plan. Scanlon Plan participation is valuable probably because workers realize that useful participation is well rewarded and because it is very low key, being concerned with day-to-day activities.

Geare, A. J., "Productivity from Scanlon-Type Plans," The Academy of Management Review, pp. 53-58, July 1976.

A.2.9. Chapter 12. Willingness

THE ABSORPTION RATE OF IDEAS

G. Gallup

Abstract

Gallup feels that although the merit of an idea is important in determining its life or death, its acceptance in the market place depends upon many other things. A period of integration, which follows acceptance, can be described as a period of absorption, a period when the idea becomes incorporated into the thinking process. Gallup describes several factors which seem to determine when an idea will be put to work. They are the complexity of the idea, its differences with accustomed patterns, competition with prevailing ideas, whether it can be demonstrated and proved, the frequency with which the public is reminded of the idea, etc. Gallup goes on to be very critical of those who equate learning with formal education. He feels that the enemy of learning at the university level is the text book, the classroom lecture, and the course and credits system. Gallup feels an attempt to measure the success of the educational system on the basis of quality of the product of the system. In conclusion, Gallup feels confident that a new conception of education would evolve from such a research project, and that concept would be far better suited to the present needs of the nation.

Gallup, G., "The Absorption Rate of Ideas," Public Opinion Quarterly, pp. 234-242, Fall 1955.

INNOVATION-RESISTING AND INNOVATION-PRODUCING ORGANIZATIONS

Herbert A. Shepard

Abstract

The author proposes that exploration of the innovative process in organizations can conveniently proceed along two paths: first, how innovation is induced in settings which are resistant to innovation; and second, how to design an organization which is productive of innovations rather than resistant to them. A third path emerges out of an examination of the first two, namely, the exploration of a particular class of innovations, those which change an innovation-resisting organization into an innovation-producing one or vice versa. He then analyzes and compares the process of innovation in innovation-resisting organizations and in innovation producing organizations.

The author concludes that there are many organizations attempting to become innovation producers within a framework of managerial assumptions and practices which are appropriate for innovation-resisting organizations. For them, the innovative processes which should be of greatest interest are ones which would help them to adopt and implement a framework more appropriate for the task.

Shepard, Herbert A., "Innovation-Resisting and Innovation-Producing Organizations," The Planning of Change (2nd ed.), W. G. Bennis, K. D. Benne, and R. Chin (editors), Rinehart and Winston, New York, New York, 1969, pp. 470-477.

MANAGING TECHNOLOGICAL CHANGE: A BOX OF CIGARS FOR BRAD

Frederick W. Gluck and Richard N. Foster

Abstract

This fictional account of a technology-based company illustrates problems that can occur when product and process design decisions are made at the technical level. These technological decisions involve tradeoffs which impact upon manufacturing costs, product features, reliability and introduction dates. Yet, when these decisions are made at the technical level, the individuals making them are at such a low level within the organization that they may not be able to see the overall picture. The need is there for top corporate management to become involved in the technological realities or else the company may soon find itself with a technologically obsolete product. Management must become involved at the very beginning of a new process or product's life. By monitoring the project through the study, design, development, preproduction and production phases, management ensures that the project continues to meet its objectives. By focusing on the generation of ideas, testing of assumptions, raising of issues, modifying and introducing concepts, establishing performance specifications and assessing risks, management is involved in the product's entire preproduction life.

Gluck, Frederick W., and Foster, Richard N., "Managing Technological Change: A Box of Cigars for Brad," Harvard Business Review, vol. 53, no. 5, pp. 139-150, September-October 1975.

THE MIDDLE MANAGER AS INNOVATOR

Rosabeth Moss Kanter

Abstract

If there's one thing that most U.S. executives agree on, it's the need for higher productivity in American workplaces. So far most efforts at raising performance have concentrated on factory and office employees--partly, one assumes, because their output is easily measured. However, the increases in productivity at the shop or office level will mean nothing in the long run. If, for instance, new products aren't designed, new structures aren't put in place to accommodate change, or new equipment isn't conceived to improve product quality. In other words, a company's productivity depends to a great degree on how innovative its middle managers are.

In this article, the author describes a study she conducted of 165 middle managers in five companies to determine what managers contribute to innovation and what factors the most innovative companies have in common. She found that, among other things, innovative managers tend to be visionary, comfortable with change, and persistent. Innovation flourishes in companies where territories overlap and people have contact across functions; information flows freely; numbers of people have excesses in their budgets; many managers are

in open-ended positions; and reward systems look to the future, not the past.

Kanter, Rosabeth Moss, "The Middle Manager as Innovator," Harvard Business Review, pp. 95-105, July-August 1982.

JOB SECURITY, TECHNICAL INNOVATION AND PRODUCTIVITY

Bruce E. Peters

Abstract

Citing the progressive managerial style of Scottish textile magnate Robert Owen during the Industrial Revolution, the author purports that technological innovation can be accepted by labor. The key, both historically and currently, to change and innovation lies in job security. IBM, as an example, has not laid off an employee for economic reasons in thirty-five years. As a consequence, they get a high degree of cooperation from the work force in making changes that are beneficial to the corporation; and in a high technology business, this is crucial. Other companies, such as Kimberly-Clark Corporation, have had similar success introducing technological change when workers felt that their jobs were secure. Some ways of achieving job security have been to shorten work weeks or temporarily employ production workers as company salespersons in times of economic recession.

Recent examples have shown that, just as in the Scottish Industrial Revolution, employees will accept changes in technology if their job security is assured. Some companies have failed to recognize the security needs of employees who are in a position to reject innovation or ensure its failure. New methods and techniques of "soft" technology would require a search for new ways of management; but once the necessity to

ensure job security is realized at the management level, we may finally be able to profit from Robert Owen's innovations and those of subsequent years to gain higher productivity.

Peters, Bruce E., "Job Security, Technical Innovation and Productivity," Personnel Journal, v. 57, pp. 32-35, January 1978.

THE RESPONSIBLE MANAGEMENT OF TECHNOLOGICAL CHANGE

Leonard H. Peach

Abstract

The successful management of technological change within an organization requires management attention to the human factors. Technological innovation can be regarded by the workers as threatening; and, unless appropriate personnel policies are established and implemented, the adjustment to technological change can be slow, painful and costly for the workers, management and society. Successful redeployment and retraining of employees affected by technological innovation requires time, money, employee motivation and management motivation. Prior to the actual introduction of a new technology there is generally sufficient warning time which should be used to develop and implement redeployment and retraining plans. To alleviate employee fear of loss of job security, management must develop both short-term and long-term manpower plans aimed at minimizing the impact on employment. If properly handled, technological change can provide job enrichment, greater motivation and increased confidence in the organization.

Peach, Leonard H., "The Responsible Management of Technological Change," Personnel Management, v. 5, no. 8, pp. 18-21, August 1973.

WHY INNOVATIONS FAIL

Sumner Myers and Eldon E. Sweezy

Abstract

Countless innovations fail because no one wants or needs them. But too often, good ideas are lost to poor management. The authors present the result of a study of 200 failed innovations, which shows some of the more important factors that contributed to the failures. Among these were uncontrollable market factors, limited sales potential, and poor management. The authors conclude that more than one-third of the cases studied would have benefitted from a systematic stepped technique of continuous evaluation that would have forced management to ask the right questions at the right time.

Myers, Sumner, and Sweezy, Eldon E., "Why Innovations Fail," Technology Review, pp. 41-46, March/April 1978.

UNCSTD WAS NOT A TECHNICAL FAILURE

M. Wionczek

Abstract

Two weeks of negotiations at the UN Conference on Science and Technology for Development in Vienna in August produced little of substance in the Program of Action. No new commitments were made by the industrialized or developing countries, and major problems and confrontations were put off. "While technically the UNCSTD cannot be described as a failure, its contribution to the international mobilization of science and technology is close to nil." Because of its weaknesses, divisions, and limited political and technical competence, the developing countries' Group of 77 did not want any confrontation with the industrialist countries despite the group's threatening voices. Reasons for dodging the confrontation may have been to avoid the issues related to the poor state of science and technology in their countries, to avoid further intra-group divisions, and to avoid self-incrimination. Their overall science and technology condition is not just the results of their colonial pasts, but also a socially harmful distribution of resources and expenditures on arms and other "consumption" goods. The developing countries could have made their case more convincing by commitments to the development of science and technology, but this would have required painful soul-searching, domestic reforms, and

reallocation of resources. The industrialized countries did not want to raise similar issues because of their current, painful economic crisis. Exposed to growing domestic, political and social tensions, the industrialized countries are attempting to isolate themselves from international transmission of the crisis through protective policies.

Wionczek, M., "UNCSTD Was Not a Technical Failure," The Bulletin of the Atomic Scientists, pp. 50-55, December 1979.

A.3. SECTION C. TECHNOLOGY TRANSFER APPLICATIONS

In recent years, considerable effort has been given to enhancing the movement of technology and innovation. At all levels, the transfer of technology ensures that the benefits of innovation are made available to potential users. This section addresses four levels at which technology transfer plays a prominent role in the implementation of innovation and change. Chapter 13 focuses on the presence and impact of technology transfer at the city, county and state levels. Chapter 14 examines the role of federal laboratories and the federal government in ensuring the transfer of government sponsored innovation to other users. Technology transfer in industry, or the private sector, is the topic of Chapter 15. Chapter 16 concerns international technology transfer and the impact it is having on both technologically developed nations and on developing nations.

Obviously the transfer of technology is not limited to these four sectors. The selections in this section reflect the extent to which innovation is transferred among all the levels of government, both internationally and interngovernmentally within the United States, as well as between government and the private sector and within the private sector itself.

A.3.1. Chapter 13. Technology Transfer at the City-County-State Level

MASTER PLAN FOR THE FUTURE: LOCAL GOVERNMENT ISPT/NSF

Bruce J. Reiss

Abstract

Bruce Reiss heads the Local Government Program in the Office of Intergovernmental Science & Public Technology, National Science Foundation, with a prime responsibility toward insuring that the results from the nation's investment in science research are effectively utilized. He is active in integrating work between the Federal Laboratory Consortium and various elements in the public sector. He has played a major role in establishing networks of potential users of science and technology, particularly in the public sector. Mr. Reiss explains the innovation networks which have been developed as innovative Federal thrust to further the effective and appropriate use of the nation's science resources.

The National Science Foundation has been increasingly active in recent years in efforts to improve the usefulness of the nation's scientific effort. The Office of Intergovernmental Programs has a major responsibility in this area.

This general approach is one of responding to needs, by supporting the establishment and, in some cases, establishing networks of potential users of knowledge. They also encourage and sometimes coordinate the support activities behind the functioning of the networks. The networks systems are

described, the support organizations, and the general functioning of the entire system.

Reiss, Bruce J., "Master Plan for the Future: Local Government ISPT/NSF," pp. 53-59 in Creighton, J. W., and Jolly, J. A. (ed), Technology Transfer: Research Utilization and User Stimulation, Naval Postgraduate School, Monterey, California, 1980.

NEW FINDINGS ON THE TRANSFER OF COMPUTING APPLICATIONS AMONG CITIES

Kenneth L. Kraemer and John Leslie King

Abstract

This paper presents a study of the concepts of transferring computer technology among city governments. A sample of cities from a domestic population and an international population are used as the basis of the research. Contrary to expectation, and for both populations, the survey indicated the level of computer applications transfer among cities was found to be low compared to the amount of total application development. It was determined that an important source of transfer information was from "centers" such as the federal government, vendors, and transfer agencies, rather than city to city. International cities that were studied seem to experience a propensity toward centralized control at the national level. These controls often include the transfer of technical information. Further, the types of transfer may vary widely between the domestic vs the international cities. That is, domestic city transfers tend to be operations-oriented, while transfers from national centers tend to be management oriented. In general the study supported prior conclusions concerning the difficulties of transfer. The problem of mismatch and difficulties in modification make transfers very risky. Even so, there are many persons

willing to take the risks in order to try to achieve lower costs and to realize the opportunity to obtain sophisticated applications.

Kraemer, Kenneth L, and King, John Leslie, "New Findings on the Transfer of Computing Applications Among Cities," Journal of Technology Transfer, 4(1), pp. 99-110, 1979.

BUREAUCRATIC INNOVATION IN URBAN GOVERNMENT: A POLICY MODEL

Richard D. Bingham

Abstract

The paper reports the results of a study examining the diffusion of innovations across four different units of local government. Using partial correlation coefficients to test a hypothesized model, the variables were successful in explaining the adoption of process innovations but showed limited success in explaining product adoptions. Socio-economic variables were not found to be significant direct determinants of innovation. Demands for innovations, organizational characteristics, and the organizational environment were much more important predictors of the use of innovations by local governments.

Bingham, Richard D., "Bureaucratic Innovation in Urban Government: A Policy Model," Journal of Technology Transfer, 2(2), pp. 17-33, 1978.

INDUSTRY AS A MECHANISM FOR URBAN TECHNOLOGY TRANSFER

Deborah D. Roberts, David L. Wilemon, and Paul J. Flynn

Abstract

This paper is based upon research done under the National Science Foundation sponsored study The Role of Industry in Urban Technology Transfer: A Comparative Profile. The purpose of the research is to investigate specific industries that serve the urban market of local governments. The research aim is to develop an understanding for the barriers and incentives that affect industry's ability and desire to produce and market technological innovations for cities.

Roberts, Deborah D., Wilemon, David L., and Flynn, Paul J., "Industry as a Mechanism for Urban Technology Transfer," Journal of Technology Transfer, 4(1), pp. 15-37, 1979.

TECHNOLOGY TRANSFER OF COMPUTER-BASED APPLICATIONS IN LAW ENFORCEMENT

Kent W. Colton and James M. Tien

Abstract

As the use of computer-based technology has expanded in law enforcement, one of the central questions is how technology transfer has contributed to this development. Drawing on a range of past and current research studies, the paper notes that the expectations of transfer have often exceeded the realities. Factors which both inhibit and enhance technology transfer in law enforcement are therefore outlined, and recommendations for the future are set forth.

Colton, Kent W., and Tien, James M., "Technology Transfer of Computer-Based Applications in Law Enforcement," Journal of Technology Transfer, 4(1), pp. 63-76, 1979.

A.3.2. Chapter 14. The Federal Sector

TECHNOLOGY TRANSFER: A LOOK AT THE FEDERAL SECTOR

Kenneth E. Egide

Abstract

An important resource in the search for solutions to serious issues confronting the United States is the science and technology which result from Federally funded research and development. To obtain the optimum return on this significant investment requires that the resultant technology be adapted for secondary utilization and/or be transferred to primary and secondary users. This article describes the magnitude and scope of Federally sponsored research and development and describes the major Federal technology transfer efforts. While present technology transfer efforts, mostly passive, are necessary, there is need for more active methods. The Federal government is seeking ways to improve its technology transfer effort. General agreement on the following actions appears to exist: stronger support by Federal research and development management, and increased commitment of personnel and funding to the Federal technology transfer effort.

Egide, Kenneth E., "Technology Transfer: A Look at the Federal Sector," paper submitted for publication in The Journal of Technology Transfer, June 1981.

AN OVERVIEW OF FEDERAL TECHNOLOGY TRANSFER

Alfonso B. Linhares

Abstract

The question before the conference (at which this paper was presented) is, "Should there be a centralized federal office of technology transfer?" Obviously the question can raise a wide range of interpretations of the role and responsibilities of such an "office." At one end of the spectrum could be envisioned a new agency responsible for doing all of the technology transfer activities of the Federal Government. While the other end might consist of a small office responsible for coordination of activities across federal agencies.

The author believes few people would propose the former role. Technology transfer interests at the federal level encompass such a wide range and diversity of interests and user groups, and are so clearly allied to the functional support responsibilities of the various federal agencies, that no one agency could undertake the "doing" of the entire job of federal technology transfer.

On the other hand, it is generally concluded that there has not been enough emphasis on technology transfer activities at the federal level, and the creation of an identifiable organization responsible for such activities is a way of assuring attention to, and action on, the subject. Also,

since the Federal Government is generally functionally oriented and organized, technology transfer activities aimed at general-purpose governments and at areas which fall between the functional responsibilities of existing federal agencies has been somewhat lacking. Although a much greater emphasis is developing in this area, additional efforts appear necessary.

The author concludes that an "office" is needed and that the new Office of Science and Technology Policy provides the basis and the structure of such an office. It does not need to be a large office since by far the majority of the actual technology transfer activities are accomplished by existing federal agencies and programs. But it would provide the necessary high level focus and "entry point" for policy level interests in state/local government and private industry and would also assure continuous attention to federal technology transfer activities.

Linhares, Alfonso B., "An Overview of Federal Technology Transfer," Journal of Technology Transfer, 1(1), pp. 13-31, 1976.

EVALUATION FRAMEWORK FOR FEDERAL TECHNOLOGY TRANSFER INITIATIVES

Thomas C. O'Brien and Lawrence M. Franks

Abstract

Improved efforts to transfer the results of Federally-sponsored R&D to industry are cited often as an approach to help reverse declines in the rate of growth of U.S. industrial productivity and in the international competitiveness of certain industry sectors. As taxpayers and policy makers intensify their demands for accountability of public expenditures, technology transfer advocates must develop and apply analytic approaches which will measure the significant short and long-range impacts of Federally-sponsored programs, even though these impacts are especially difficult to measure directly.

This paper suggests a framework for evaluating Federal technology transfer in terms of short and long range goals and outputs. It outlines critical determinants of program success and suggests performance indicators through which results could be measured.

O'Brien, Thomas C., and Franks, Lawrence M., "Evaluation Framework for Federal Technology Transfer Initiatives," Journal of Technology Transfer, 6(1), pp. 73-86, 1981.

WORKING GROUP REPORTS--
NATIONAL RESOURCE MANAGEMENT TECHNOLOGY

J. Grey and M. Newman

Abstract

This article was the fifth of six reports and focused on aerospace technology transfer in the area of resources and the environment. NASA technology transfer efforts to foreign, national, state, regional, and local governments are currently accelerating. Past experiences have uncovered many problems in the transfer process. On NASA's side they include: (1) the lack of an overall strategy and of a coordinated, organized approach to technology transfer, (2) a tendency for working with technologists rather than with decision-makers and technologists, (3) inadequate staff and financial resources to complete the transfer effort, and (4) a shortage of formal state and local input to technological activities. On the state and local government side, problems encountered have included: (1) fragmentation among many agencies with differing viewpoints and needs, (2) a shortage of financial resources and expertise, (3) bureaucratic resistance to accepting new technologies, (4) inadequacy of communication between and within states, and (5) political, administrative, and social problems related to the adoption of new technologies.

Grey, J., and Newman, M., "Working Group Reports--National Resource Management Technology," Aerospace Technology Transfer to the Public Sector, pp. 44-49, June 1978.

INTERGOVERNMENTAL COOPERATION IN SCIENCE AND TECHNOLOGY

Joseph E. Clark

Abstract

A review is made of the distribution of the 37 billion dollar Federal R&D effort. The Federal research and development is charted to show its relationship to national needs. An analysis of state and local government expenditure as related to national needs is also charted. An additional analysis shows that about one-half of all state and local government research and development funds come from Federal agencies. This dollar source, by agency, is also charted. An attempt is made to match Federal agency research and development effort to a list of priority problems identified by state and local government. This analysis reported that some 325 Federal agency sponsored research and development programs can be identified as having substantial benefit or impact on state or local government priority problems.

Clark, Joseph E., "Intergovernmental Cooperation in Science and Technology," Journal of Technology Transfer, 6(1), pp. 1-17, 1981.

DEPARTMENT OF DEFENSE TECHNOLOGY TRANSFER CONSORTIUM: AN OVERVIEW

George F. Linsteadt

Abstract

The federal R&D laboratories represent a large technology resource which may be applied to civilian needs. These laboratories, located throughout the nation and operating on annual budgets of several billion dollars, can supply technical assistance and management support to those state and local governments and private industry who are attempting to solve the nation's problems. Many of these laboratories are actively seeking to share their facilities and expertise with those public and private agencies who have compatible requirements. The Department of Defense Technology Transfer Consortium, as a subset of the Federal Laboratory Consortium for Technology Transfer, is actively participating in such an endeavor. This article describes the Federal Laboratory Consortium for Technology Transfer and discusses its limitations as well as its attributes.

Linsteadt, George F., "Department of Defense Technology Transfer Consortium: An Overview," Journal of Technology Transfer, 1(1), pp. 107-117, 1976.

CHAMPIONS FOR RADICAL NEW INVENTIONS

Donald A. Schon

Abstract

This article attempts to answer the following questions: why do small companies, large corporations, military laboratory employees, and independent inventors find it so difficult to sell really new inventions to the military services? What is the nature of resistance to innovation in military and business organizations? What does experience show to be the requirements of successful technical innovation? What steps can management take to ensure that the necessary development work will go into promising proposals for radical new products and processes? Both military services and business are caught in the gap between the wish for deliberate and systematic methods of innovation and the uncertainty and risk inherent in this activity. The significance of the resources for invention that are being wasted and the reasons that this waste continues to go on are then suggested. In the military there are significant resources of innovation for which there is an expressed need, and there is a screening organization whose main function is to serve as a buffer against them. When successful innovation does take place, four themes were present: 1) At the outset, the idea encounters sharp resistance. 2) Next, the idea receives active and vigorous promotion. 3) The proponants make use of the

informal, rather than the official military system. 4) Typically, one man emerges as a champion of the idea.

Schon, Donald A., "Champions for Radical New Inventions," Harvard Business Review, March/April 1963, pp. 77-86.

A.3.3. Chapter 15. The Private Sector Approach

TECHNOLOGY TRANSFER AND UTILIZATION: ACTIVE PROMOTION OR PASSIVE DISSEMINATION

Phillip Wright

Abstract

This article presents the results of a study undertaken by the Office of Industrial Applications at the University of Maryland to study the transfer of technical knowledge to industry from the National Aeronautics and Space Administration. The first phase of this program was to actively promote NASA technology to industry and the second phase involved the careful examination of the processes involved in the final utilization or discarding of the information supplied.

The study contacted 21,000 organizations of which 5300 showed interest. A high drop-out rate was experienced and by the end of the study 89 companies were actively involved and thirty of these were able to show an effective utilization of the NASA technology.

The author continues by examining the reasons for industry interest and disinterest of technology transfer. The most important conclusion reached is that industry is almost eight times more motivated by the possibility of improving an existing process or product through the use of technology transfer than by the addition of a completely new product or process. The reason for this is that this type of innovation results in a smaller disruption of the industrial

equilibrium than the introduction of something totally new.

Wright, Phillip, "Technology Transfer and Utilization: Active Promotion or Passive Dissemination," Research/Development, September 1966, pp. 34-37.

SOME PROBLEMS OF TECHNOLOGY TRANSFER INTO INDUSTRY: EXAMPLES FROM THE TEXTILE MACHINERY SECTOR

R. Rothwell

Abstract

Since the Second World War, the textile machinery industries in the advanced Western countries have undergone a technological revolution. Not only has the pace of technical change increased, but much of this change has become technically more radical than before, often embodying techniques from other sectors. This paper outlines the attempts of a number of machinery manufacturers to import technology and technical expertise from a variety of external sources including universities, government labs, and technical consultants. It shows that while the characteristics of the various donor and recipient organizations might differ greatly, the factors associated with the success or the failure of the transfer attempts are often similar. More importantly, it shows in almost all of the failure cases described, that with proper management they could have been transformed into successful transfers leading to successful innovations.

Rothwell, R., "Some Problems of Technology Transfer into Industry: Examples from the Textile Machinery Sector," IEEE Transactions on Engineering Management, v. EM-25, pp. 15-20, February 1978.

WORKING GROUP REPORTS--HOUSING AND URBAN CONSTRUCTION TECHNOLOGY

J. Grey and M. Newman

Abstract

This article was the third in a series of six which dealt with aerospace technology transfer to the public sector. Aerospace technology has had a significant impact in the field of housing and urban construction. Among the most noted contributions are: design and management techniques, the application of the systems approach, development of building system components, environmental systems, and energy conscious design and construction of the urban environment. Probably the single most important ingredient of successfully transferring aerospace technology to the public sector is the role played by people in the process. The key appears to be a catalyst or change agent, in the form of an individual, who can identify a need, define the specifications and parameters that a solution must meet, locate the appropriate technology, effect the transfer, and champion the project until it becomes institutionalized. Other areas of consideration include the imaginative use of the procurement process to stimulate technology transfer and increase the rate of acceptance, interacting with consumer protection groups, and providing a centralized financial assistance base.

Grey, J., and Newman, M., "Working Group Reports--Housing and Urban Construction Technology," Aerospace Technology Transfer to the Public Sector, pp. 31-35, June 1978.

TECHNIQUES FOR TECHNOLOGY TRANSFER WITHIN THE BUSINESS FIRM

J. M. Stewart

Abstract

The first section of this paper presents a brief background, examples of successful commercial and military transfer, and definitions of four types of transfer, and points out that transfer is 'upstream' as well as 'downstream'. The technique for transfer within the firm are presented in a framework of fourteen dimensions, as follow: management intent or objectives; normal information mobility; balance of the business functions; motivation to transfer; potential for transfer; form of technology; sophistication gap; scale of investment; measurability of success; duration of transfer; breadth of transfer; perception of implications; extent of boundaries between functions; degree of top management interest. After each dimension is defined, examples of specific techniques used by successful companies are outlined.

Stewart, J. M., "Techniques for Technology Transfer within the Business Firm," IEEE Transactions on Engineering Management, v. EM-16, no. 3, pp. 103-110, August 1969.

PRODUCTIVITY AND TECHNOLOGY IN THE ELECTRIC LAMP INDUSTRY

Richard B. Carnes

Abstract

Due to the strong demand for lighting fixtures, lamp manufacturers have had to dramatically increase production to satisfy demand. Technological advances have played a large role in increasing the industry's level of productivity. The industry output increased fifteen-fold between the years of 1920 and 1977 with only a doubling of the work force.

The advent of mass production was instrumental in the aforementioned productivity increase. Additionally, improvements in basic lamp making machinery are estimated to have increased production from about 1,000 per machine hour in 1954 to a little over 3,000 lamps today.

The presence of the energy shortage has had a negative effect on the electric lamp industry's productivity level. This is largely because manufacturers have had to revert back to more labor intensive methods in attempts to cut back on energy usage. The energy crisis has also had the opposite effect of stimulating productivity gains by encouraging new innovative energy saving lighting developments. High intensity discharge lamps which provide increased lighting for the amount of energy expended seem to hold the greatest promise for the future.

Carnes, Richard B., "Productivity and Technology in the Electric Lamp Industry," Monthly Labor Review, pp. 15-19, August 1978.

TECHNOLOGY AND LABOR IN AUTOMOBILE PRODUCTION

Robert V. Critchlow

Abstract

Technological innovations in the motor vehicle industry have dramatically increased its productivity. Significant gains have resulted from such means as wider usage of computers, increased application of numerical control techniques, improvement in transfer lines and automatic assembly machinery.

Computers have proved beneficial in speeding up the research and development process. Their usage has also been instrumental in such production functions as work scheduling and quality control in machining.

A direct effect of the technological innovations in this industry is a change in the complexion of the work force. The semi-skilled worker will be displaced by skilled workers, especially in the computer related occupations. This will entail a major retraining program in the motor vehicle industry.

The focus of the industry research and development in the future will be to design cars that can meet the government standards for exhaust pollution and fuel economy. This should result in an increased emphasis on the small, light weight auto design, as well as refinements in engine design.

Critchlow, Robert V., "Technology and Labor in Automobile Production," Monthly Labor Review, pp. 32-35, October 1977.

THE ROLES OF SCIENCE IN TECHNOLOGICAL INNOVATION

M. Gibbons and R. Johnston

Abstract

The authors investigated the various mechanisms by which scientific research and education contribute to industrial innovation. They sampled innovations from industries which were categorized as to their level of annual expenditure on R&D expressed as a percentage of their total net output. Information was broken into units on the basis of content and source. The sources of information included external, internal, and personnel information sources. It was found that these three sources were used approximately equally. With regards to content, information dealing with properties, composition, and characteristics was used most frequently in the resolution of technical problems. Sources external to the company provided information about the existence of material and general law and theories, whereas internal information was concerned with the properties of materials. Performance of R&D constituted internal information. The authors concluded that the relationship between science and industrial technology is complex and requires further research.

Gibbons, M., and Johnston, R., "The Roles of Science in Technological Innovation," Research Policy, pp. 220-242, 1974.

A.3.4. Chapter 16. International Technology Transfer

INTERNATIONAL TECHNOLOGY TRANSFER: RAMIFICATIONS CONCERNING COMMUNIST BLOC NATIONS

Howard C. Fish

Abstract

The complexity of national and international facets of technology transfer--including military security, impact on world markets and economics, ideological image, and resultant human and social impacts--are discussed with a view toward public formulation. The transfer of technology related to development of productive capacity and computers within the People's Republic of China, and the paucity of factual information, developing trends, and future studies of technology transfer in the USSR are used to illustrate the relationships of these facets. The implicit exhortation of this survey is that in all policy formulation procedures consideration of all facets be assumed, particularly those relating to human and social impacts.

Fish, Howard C., "International Technology Transfer: Ramifications Concerning Communist Bloc Nations," pp. 31-39, Technology Transfer in Science, Technology and Public Policy, Jolly, J. A., Creighton, J. W., and Moore, B. M. (eds), Naval Postgraduate School, Monterey, California, 1978.

ADAPTING TO THE FOREIGN TECHNOLOGICAL CHALLENGE

Sherman Gee

Abstract

United States technology is increasingly viewed as providing the backbone and where-withal to arrest the nation's economic slide and to restore the accustomed U.S. leadership position in international trade. This view stems from demonstrated U.S. preeminence in technology, the importance of technology in economic growth, and the ascendance of technology in foreign affairs and international trade today. But, undue preoccupation with the domestic technology base represents at best a suboptimum strategy in the face of a continuing decline in the national investment in R&D. In view of the incipient shifting of the world technological balance overseas, comparable attention needs to be focused on foreign technological developments, and their potential for import and adaptation to help fuel technological innovation at home. A more balanced mix of foreign and domestic technological ingredients in the U.S. socio-economic cauldron promises to be more attuned to the reality of scarce domestic resources and the changing world environment.

This paper was presented at the IEEE/MTS OCEAN 75 Conference, San Diego, California, 22-25 September 1975.

Gee, Sherman, "Adapting to the Foreign Technological Challenge," Journal of Technology Transfer, 3(1), pp. 7-13, 1978.

THE ACCELERATION OF INTERNATIONAL TECHNOLOGY TRANSFER

Abstract

This article discusses the efforts being made to speed the pace of international technology transfer. The U.S. has been the primary generator of technology in the last 20 years, but our contribution, on a percentage basis, is decreasing. The current U.S. effort is concentrated on helping developing countries, while generally, encouraging the transfer of technology among nations. The multinational corporation has been the major channel of technology transfer. The government part includes many joint commissions, particularly in the areas where industrial and technical activity is largely run by the government. Programs and agencies involved in the global transfer of technology include the U.S. Patent and Trademark Office, which is involved with the international use of patents, trademarks, trade secrets, etc. The Commerce's NTIS has filed patents in foreign countries for government-owned inventions developed by Commerce Department agencies or if transferred to the NTIS, which holds an annual seminar for the standards, testing laboratory, and industrial quality control officials of developing countries.

"The Acceleration of International Technology Transfer," Commerce America, vol. 1, No. 7, pp. 7-11, March 1976.

THE TRANSFER OF TECHNOLOGY TO DEVELOPING COUNTRIES: A CRITICAL ANALYSIS REGARDING VENEZUELA

Manuel Suarez

Abstract

The process of technology transfer implies the existence of the need for technology by a party that lacks it and, for some reason, wants it. In this article, two specific categories of technology transfer are discussed. One type of transfer concerns technology that has been developed in the field to solve a particular problem or a group of problems and could also have application in other fields. As an example, management techniques developed by the Air Force could be applicable for solving similar problems in other government agencies or in the private sector. Such a transfer recently took place between the Venezuelan Air Force and the University of the Andes. The second type of transfer is the extension of technology already well developed to new users who had previously been unaware of it. Between developed and developing countries, this is a common situation.

The first type of transfer involves a new technology or application of existing technology or application of existing technology to bring about change. The second type introduces a revived technological development to societies who have fallen behind in their research and development programs. In this article, emphasis is placed on the second type of

technology transfer particularly as it applies to Venezuela, a country in search of the technology that is necessary for its industrial development.

Recently, talk has arisen of "appropriate technology." This term is defined as technology appropriate for the conditions of the user. It would include the adaption of foreign technology to the particular conditions of the user domestic market, and might require the development of intermediaries in government organizations or in industry. These intermediaries would act as linkers between the sources of technology and the consumers of it. This paper presents a summary of the process of technology transfer from industrial countries to the developing ones.

Suarez, Manuel, "The Transfer of Technology to Developing Countries: A Critical Analysis Regarding Venezuela," Journal of Technology Transfer, 3(1), pp. 21-34, 1978.

SCIENCE AND TECHNOLOGY: REPORT FROM THE PRESIDENT

J. Carter

Abstract

In a message to the Congress on March 27, 1979, President Carter described the Administration's policy perspective on science and technology, highlighted some of the most important initiatives undertaken in the area, and outlined the potential effects of science and technology in the coming decade and beyond. This report is an excerpt from that message. One theme that has shaped the administration's policy is formulating programs and institutions that help developing countries use science and technology. The U.S. has an opportunity and responsibility to share scientific knowledge and appropriate technological skills with the developing world. Our purpose is to assist other countries in developing technology for their own needs. We must accomplish this purpose both for humanitarian reasons and because overcoming the problems of poverty, overpopulation, and scarcity of food and natural resources will promote a stable world, enhancing our security and well-being. Recognizing these facts, the President submitted legislation to create an Institute for Scientific and Technological Cooperation, which will be charged with helping developing countries improve their scientific and technological capacity. Working with the Agency for International

Development, the Institute would exapnd the use of science and technology to overcome obstacles to development.

Carter, J., "Science and Technology: Report from the President," Department of State Bulletin, pp. 42-44, June 1979.

TECHNOLOGY TRANSFER TO DEVELOPING NATIONS

Herbert H. Rosen

Abstract

What's a developing nation? For that matter, what's technology transfer? When put in the context of exporting and importing technology, the answers are moot. Transfer still turns on how much someone--developed, developing or undeveloped--is willing to pay for the technology, and whether there is an identifiable need that it can satisfy with a minimum of sophistication. The simpler--and cheaper--the better. That may very well become the theme of a new worldwide movement called "appropriate technology," which, among several other matters, is also discussed in this paper.

Rosen, Herbert H., "Technology Transfer to Developing Nations," Journal of Technology Transfer, 1(2), pp. 93-103, 1977.

THE TRANSFER OF TECHNOLOGY TO UNDERDEVELOPED COUNTRIES

Gunnar Myrdal

Abstract

Technology cannot directly be transferred from developed countries to underdeveloped countries. Scientific-industrial technology must be adapted to the conditions prevailing in the country. Also, technology transfer has a high cost involved in royalty payments for licenses and know-how. And the dynamic problem is that underdeveloped countries not only must attempt to approach a much higher level of science and technology but also they must reach for science and technology that are continually and rapidly moving to a higher level.

The author concludes that development of these countries requires increased and more radical efforts: speedier and more effective reforms and aid appropriates in the budgets of developed countries of a greater amount than at present.

Myrdal, Gunnar, "The Transfer of Technology to Underdeveloped Countries," Scientific American, vol. 231, pp. 172-180, September 1974.

A.4. SECTION D. PUBLIC POLICY ISSUES

This section examines the influence of technology and innovation on society and the impact of public policy on the transfer of technology. Chapter 17 focuses on the economic considerations of technology transfer, both nationally and in the private sector. How the transfer of technology is affected and effected by patent laws, licensing, and trade agreements is considered in Chapter 18. The controversial subject of governmental intervention in technological innovation and transfer is presented in Chapter 19. The last chapter addresses yet another controversial issue, the relationship between the useful transfer of technology and the maintenance of security and national defense.

The articles in this section provide an overview of how technology transfer interfaces with government and society. By gaining insight into the far-reaching ramifications of the transfer of technology, the manager is able to gain a better appreciation for technology tranfer as an effective and consequential management tool.

A.4.1. Chapter 17. Economic Considerations of Technology Transfer

IMPACT OF THE SPACE SHUTTLE PROGRAM ON THE NATIONAL ECONOMY

C. M. Merz, T. A. Gibson, and C. Ward Seitz

Abstract

An Input-Output model constructed and operated at the University of Maryland was used by economists at North American Rockwell Corporation to measure and compare the economic impact of three large programs of a national scale. Compared were: (1) the Space Shuttle program; (2) a residential housing construction program; and (3) a program to increase personal consumption expenditures. For each program, the increase in production and employment in each sector of the economy and the effect upon the balance of trade were estimated.

This study is considered an excellent example of cooperation between academic and industrial economists in presenting relevant comparisons to aid the policy formulation and decision making processes.

The aggregate impact upon production and employment was quite similar for the three programs, but these impacts were distributed differently throughout the various sectors of the economy. Input-Output multipliers were found to be 2.1 for the Space Shuttle, 1.7 for housing construction, and 2.0 for personal consumption. It was concluded that an aerospace

program such as the Sapce Shuttle would be at least as good a stimulus to the economy as other types of programs.

Merz, C. M., Gibson, T. A., and Seitz, C. Ward, "Impact of the Space Shuttle Program on the National Economy," Engineering Economist, vol. 18, no. 2, pp. 115-133, 1973.

TECHNOLOGY, PRODUCTIVITY, AND ECONOMIC GROWTH

Abstract

Technology, productivity, and economic growth are interrelated. It is estimated that technological change was the biggest source of growth in the economy over the past thirty years. It is more difficult to quantify the contribution of technology to productivity. Trends indicate that the U.S. is decreasing R&D spending as a portion of GNP, and R&D manpower as a portion of overall population. Some fear that a recent decline in the U.S.'s industrial productivity is partially attributable to the level of technological development. Proponents of this view feel that there has been a lessening of basic research activities due to government regulation, soaring costs, high new product failure, etc. Despite the decline in R&D spending, social returns from innovations are high. A social return includes savings realized from use of the innovation or when a new product provides a cheaper substitute for an old product. The article concludes that there is a need for improved measurement methods of productivity and the various contributing factors affecting its level.

"Technology, Productivity, and Economic Growth," Mosaic (September-October 1976), vol. 7, no. 5, pp. 2-7.

HOW TO SPOT A TECHNOLOGICAL WINNER

George R. White and Margaret B. Graham

Abstract

The article discusses the reluctance of many managers to commit their organization's resources to the development of new technologies. A striking example is given depicting the failure of the inventors of Xerographic copying in selling their technology to such companies as IBM and Eastman Kodak. These firms missed the opportunity to share in the tremendous profits that Xerox Corporation obtained.

The authors suggest a model to use in evaluating the probable return on a new innovation before a firm commits their time and funds to it. One of the primary qualifications an innovation should have is its ability to use a new combination of scientific principles to relieve or avoid major constraints inherent in the previous art. Additionally, the manager should consider what effect the innovation is likely to have on the business's current operation. Finally, the firm should evaluate the marketability of the product to the final consumer.

White, George R., and Graham, Margaret B., "How to Spot a Technological Winner," Harvard Business Review, March-April 1978, pp. 146-152.

INVESTMENT IN INNOVATION

Arthur M. Bueche

Abstract

This paper reviews briefly the importance of the U.S. investment in innovation. It then reiterates some of the statistics that support a growing concern related to the declining growth rate of innovation. The importance of business investment in the innovation process is identified as a key element in economic progress. Several charts and graphs are used to illustrate this point. Factors that influence investment are discussed. Finally specific recommendations are made that should be considered by both the public and private sectors.

Bueche, Arthur M., "Investment in Innovation," Journal of Technology Transfer, 3(2), pp. 1-13, 1979.

THE ROLE OF MARKETING IN TECHNOLOGY TRANSFER

Thomas M. Jacobius and Robert S. Levi

Abstract

Extensive experience has demonstrated that successful technology transfer requires a dynamic balancing of user needs and technical innovation resulting from R&D programs. This balancing process in essence represents the function of marketing in identifying and responding to 'demand pull' opportunities. By evaluating the role of marketing in the context of technology transfer, a practical perspective is provided for enhancing the potential for success of new product commercialization strategies. Observations and conclusions are drawn from the experiences at ITT Research Institute, with over fifteen years of direct technology transfer support to NASA through technical evaluations, manufacturing technology applications, and marketing feasibility studies of aerospace-derived technology.

The primary focus of this paper is market pull, or at least, demand recognition and need definition. This focus is the basic ingredient of marketing strategies designed to transfer or commericalize technological innovation. A keen perception of user needs is necessary to initially screen innovations and select those offering value to the user, as well as to provide the basis for developing a plan for

assuring successful transfer and utilization in a specific industrial or government environment.

Jacobius, Thomas M., and Levi, Robert S., "The Role of Marketing in Technology Transfer," Technology Transfer Society Symposium 1980, pp. 12-1 - 12-11.

TECHNOLOGY & ECONOMICS: PROBLEMS OR ANSWERS

John Sweeney

Abstract

Man is the center of the Universe. He was given dominion over the Earth. But he was not given an unlimited bounty; rather, he was placed in stewardship over a limited ecosystem lost in the cosmos. Only recently has the significance of this responsibility become apparent to him. The blue sky, the clear waters, the "boundless" resources are beginning to run short.

This paper postulates that an underlying cause of present energy and pollution problems is the tendency for the total costs of social actions to be hidden in the tax structure and in the degradation of the public environment. The relationship between social goals, economics, and technology is explored, and a scenario which illustrates the effects of hidden costs is described. The conclusion reached is that exposure of full costs will bring economic forces to bear toward a technological solution.

Sweeney, John, "Technology & Economics: Problems or Answers," Technology Transfer in Science, Technology and Public Policy, pp. 11-18, 1978.

TECHNOLOGY EXPORTS CAN HURT U.S.

J. Baranson

Abstract

The prevailing view has been that U.S. industry has a selfish interest in restricting the release of proprietary technology and that this attitude has safeguarded U.S. national economic interests. This view further holds that on balance, U.S. based multinational corporations have minimized U.S. losses in trade, income, and employment through judicious investment and licensing in foreign facilities, without which residual earnings would have been diminished or lost, and have obtained business in foreign markets that otherwise would have gone to foreign businesses. This viewpoint is reinforced by three assumptions: U.S. technical superiority leads all others; U.S. industry will continue to invest in R&D to maintain the lead; and there is not danger to our commerce from newly industrialized countries in the foreseeable future. Contrary to this view, U.S. multinationals may be contributing to our balance of payments problems and loss of our technological leadership by establishing foreign manufacturing affiliates and by licensing technologies to foreign manufacturers. A new generation of technology transfer arrangements gives reason for further concern. Some U.S. corporations have redefined their "self interest" such that under some circumstances, they now find attractive the sale of

industrial technology to non-controlled foreign enterprises. The technology sold is often the most sophisticated available, and is released under such favorable terms, such as long-term consulting relationships, as to practically assure the rapid ascent of the foreign firm into the international competitive market.

Baranson, J., "Technology Exports Can Hurt U.S.," Foreign Policy, no. 25, Winter, 1967-77, pp. 180-194.

A.4.2. Chapter 18. Technology Transfer by Licenses, Patents, and Agreements

PATENTS IMPEDIMENT OR EXPEDIENT TO TECHNOLOGY TRANSFER

Theodore E. Elsasser

Abstract

This paper examines the role that patents play in transferring technology. The history of our patent system and the requirements for patentability are reviewed. The option of keeping an invention as a trade secret rather than applying for a patent is presented. The paper also discusses the rationale behind the government's change in its policy which permits exclusive licensing of public-owned patents. The author concludes that patents are not a barrier but a significant help in promoting technology transfer.

Elsasser, Theodore E., "Patents Impediment or Expedient to Technology Transfer," Journal of Technology Transfer, 1(2), pp. 33-44, 1977.

TECHNOLOGY TRANSFER--HARD SELL FOR SOFTWARE

Paul Harrison

Abstract

The prime task in industrializing the Third World is to build up a broadly based indigenous capacity to develop and innovate technology. The multinationals are at present the main channel through which technology is introduced to the large scale transfer of technology suited to the development needs of most Third World countries. Their international preeminence is based on proprietary knowledge, and the wider diffusion of that knowledge is directly against their interests. Nor is it to their advantage to help Third World countries to develop strong abilities to create and innovate in technology. As for reducing costs, the multinationals will always seek to extract the maximum return from subsidiaries.

The small amount of technology that is actually transferred involves high direct and indirect costs. Costs involve high payments of royalties and licenses. The costs are inflated also through restrictive practices. Most contracts tie the recipient to purchases of raw materials and equipment from the supplier or agents. Sublicencing may be restricted. Other restrictive practices hamper the development of industry by limiting plant size, volume of production or

prohibitions on exports. The high costs reflect that the supplier has a monopoly.

Harrison, Paul, "Technology Transfer--Hard Sell for Software," New Scientist, vo. 80, pp. 352-354, November 2, 1978.

THE PATENT ISSUE--EFFECTS OF THE PATENT SYSTEM ON INNOVATION

Ray Thornton

Abstract

The forces of science, wisely used, have a tremendous, positive impact on our lives. Conversely, our technology imposes stresses upon individuals and upon institutions. Bearing in mind the unpredictable nature of the inventive process, our Federal government has not yet determined how best to promote an atmosphere which is conducive to innovation, while, at the same time, taking into account other pressing national priorities and concerns.

The involvement of the Federal government in scientific and technological affairs is not a new idea. The Constitution calls for the encouragement of innovation, but contradictions and inconsistencies in the federal regulation of research and development and in policies relating to ownership of inventions seem to be stifling the very atmosphere those policies were designed to promote and protect.

The author, a former member of the U.S. House of Representatives, examines the impact of current patent laws and antitrust laws on federally funded private research. He concludes that, to maintain the quality and quantity of innovation, the U.S. government must incorporate the industrial view in its reassessment of national research and patent policy.

Thornton, Ray, "The Patent Issue--Effects of the Patent System on Innovation," Research Management, pp. 33-35, March 1979.

A.4.3. Chapter 19. Stimulation and/or Control by Government

FEDERAL OFFICE FOR TECHNOLOGY TRANSFER: A CONGRESSIONAL PERSPECTIVE

Susan Doscher Underwood

Abstract

Questions probing the feasibility and practicability of establishing a centralized Federal Office for Technology Transfer have been around for awhile. Such questions remain unresolved as they continue to fuel discussions and debates among administrators, managers, academicians, engineers, and others concerned with the process of technology transfer.

To date the key question as to whether or not a Federal Office for Technology Transfer should be established has been effectively answered in the negative, as evidenced by relevant inaction on the part of both Congress and the Executive Branch. Whether or not existing Federal technology transfer efforts would be enhanced or hindered by the creation of such an office remains a moot point.

From a public policy perspective, colored by an awareness of Congressional procedures, persuasions, expectations, concerns, it appears inadvisable, at this time, to consider the creation of such a national office. This opinion is advanced with some qualification, and in so stating it is not to suggest that legislation backing the objectives and operation of Federal technology transfer programs is unnecessary. It is not to say that a firm Federal policy base and operational

guidelines for transfer efforts are superfluous to appropriate Executive Branch programs and activities. It appears critical that a technology transfer policy base and overall operating guidelines be formulated, but the creation of a new office would not necessarily assure the achievement of these objectives and conversely could increase the risk of further complicating Federal transfer activities.

Underwood, Susan Doscher, "Federal Office for Technology Transfer: A Congressional Perspective," Journal of Technology Transfer, 1(1), pp. 33-40, 1976.

SCIENCE, TECHNOLOGY, AND AMERICA'S FUTURE

Abstract

At the April 1975 meeting of the IEEE Board of Directors, a historic action was taken: by a vote of 27 for and 1 against, the Institute's Board adopted an official IEEE position on Federal support of research and development. This position paper, entitled "Science, Technology, and America's Future," calls on the United States Government to reverse what IEEE views as an ominous trend--the continuing decline of the real value of R&D funding in the U.S.--and, to correct this dangerous fall-off, the paper recommends specific actions by the Government to maintain R&D support at 3 percent of the gross national product.

The position paper was subsequently sent to President Gerald Ford, along with a letter from IEEE President Arthur P. Stern requesting the Administration to respond. This action represents the first time in the Institute's history that the IEEE Board of Directors has presented a sociopolitical position to the President of the United States.

The IEEE position is that reduced Federal support of research and development has threatened the United States' historic position of world leadership. The measures of national strength--gross national product, per capita consumption of energy, productivity of labor and capital, balance of trade--all reflect ultimately the impact of new and better

products and of more efficient methods of production, based on technical know-how. Prior to 1965, Federal and private support of R&D engaged an increasing share of the productive effort and resources of our country. Since 1964, the trend has been reversed. Total R&D funding fell to 2.3 percent of BNP in 1974. Federal support has dropped from 2 percent of BNP in 1964 to 1.2 percent in 1974. Unless the lagging support of R&D in the United States is replaced by healthy growth, the traditional leadership of the U.S., and the quality of life enjoyed by her citizens, will inevitably suffer.

"Science, Technology, and America's Future," IEEE Spectrum, vol. 12, no. 9, pp. 76-79, September 1975.

GOVERNMENT INTERVENTION AND INNOVATION IN INDUSTRY: A POLICY FRAMEWORK

William J. Abernathy and Balaji S. Chakravarthy

Abstract

The article begins by stating that there is a growing concern for the apparent innovation recession being experienced in the United States. It is suggested that this slow down in technology development is related to the shift away from basic research in the private sector to research concentrating on low risk, short term projects directed to improve existing products.

A study carried out by the Commerce Department concludes that government has played a large role in our innovative decline. The report states that government's decline in research and development spending as well as its increased regulation of the private sector is the main reason for this decline. Furthermore, due to the uncertainty involved in basic research, it needs strong government backing before the private sector will invest heavily in it.

The authors proceed to develop a model to evaluate the effect of government policy on the development of innovations. It is hoped that the model may be useful in shaping Federal intervention policy for stimulating innovation.

Abernathy, William J., and Chakravarthy, Balaji S., "Government Intervention and Innovation in Industry: A Policy Framework," Sloan Management Review, pp. 3-18, Spring 1979.

TOWARDS NEW NATIONAL POLICIES TO INCREASE INDUSTRIAL INNOVATION

Frank Press

Abstract

The article begins by noting the widespread concern over the decline in innovation experienced in recent years. In response to these growing concerns President Carter established the Industrial Innovation Coordinating Committee. This committee is charged with developing policy alternatives the administration can take to combat the decline in innovation.

The commission's study will largely focus on the barriers to innovation. One major barrier reported in the article is the uncertain state of the market. This lack of stability has limited the amount of investment capital business is willing to commit to research and development. This problem is coupled with a changing managerial perspective from long run goals to focusing on short term profits. These problems and others, such as restrictive Federal regulations, will be the main focus of the commission's study.

It is hoped that the commission's report will produce viable alternatives for the administration to take in stimulating the growth of innovation and therefore productivity in the United States. The alternatives developed will have to

take into consideration the limited natural resource environment now facing the country.

Press, Frank, "Towards New National Policies to Increase Industrial Innovation," Research Management, pp. 10-13, July 1978.

COMPENSATING EMPLOYED INVENTORS IN EUROPE

Willi R. Steckelberg

Abstract

This article tells how inventors are rewarded in several European countries, particularly in Germany, and gives some of the pros and cons of their systems. The author is vice president of research of the Corporate Research Division at American Hoechst Corporation. In Britain the factors taken into account to determine the inventor's fair share are the nature of the employee's duties and his remuneration, the effort and skill which the employee has devoted to making the invention, the effort and skill which any other person who is not a joint inventor has contributed to the invention, and the contribution made by the employer to the concept, development and realization of the invention by providing advice, facilities and opportunities. The German law is basically the same. The compensation payable to the inventor employee is equal to the invention value multiplied by the proportional factor as a percentage. The businesses in West Germany have learned to live with the law although they are not happy about it. The author concludes that legislated compensation for patents definitely brings about more patent applications with a chance of increasing the number of inventions, but very likely not resulting in more innovation.

Steckelberg, Willi R., "Compensating Employed Inventors in Europe," Research Management, pp. 28-31, July 1979.

SMALL IS BEAUTIFUL--TECHNOLOGY AS IF PEOPLE MATTERED

J. S. Bortman

Abstract

In this country, the appropriateness of our R&D output is in question, especially from the space and defense laboratories. How often do we hear the question, "If we can put a man on the moon, why can't we cure cancer, end hunger, make our cities livable, keep our evnironment clean, provide new energy sources?"

The role that the federal R&D laboratories should play in answering this question has been receiving much attention lately. The position of technology transfer representatives in the federal laboratory to provide a door into the federal R&D community is a relatively new one. What started as an informal group of technical representatives from a handful of DOD laboratories in 1971 has grown to a Federal Laboratory Consortium for Technology Transfer with technology transfer representatives from over 60 major federal R&D laboratories and centers.

Two of the barriers that hamper the federal technology transfer process include the bigness of the federal government--the person or group with a problem not being able to penetrate the federal bureaucracy and the appropriateness of the technology being unsuited to solve the problem.

Special efforts are being made at NADC (Naval Air Development Center) and other federal R&D laboratories to communicate with state and local agencies on a person-to-person basis, which is a key to overcoming the "bigness" problem. As communications improve, the problems of local communities can be better understood and appropriate resources can be applied to them.

Bortman, J. S., "Small is Beautiful--Technology as if People Mattered," Journal of Technology Transfer, 2(1), pp. 77-82, 1977.

THE GAO'S VIEW OF FEDERAL FOCUS FOR TECHNOLOGY TRANSFER

Osmund T. Fundingsland

Abstract

This article addresses the question "Should there be a centralized Federal office of technology transfer?" in the context of recommendations the General Accounting Office GAO) had made in 1972 and how they have and have not been implemented. It summarizes the GAO's 1972 findings, the responses to the GAO recommendations, and recent (1973/74) studies and initiatives. The article includes a discussion of Federal centralization of technology transfer, and concludes that the GAO would favor centralization of only those activities that require a Federal focus and encourage decentralization of operational programs to the maximum extent feasible.

Fundingsland, Osmund T., "The GAO's View of Federal Focus for Technology Transfer," Journal of Technology Transfer, 1(1), pp. 77-83, 1976.

A.4.4. Chapter 20. Technology Transfer's Relation to Security and National Defense

COMPUTERS, PRIVACY AND THE AMERICAN PUBLIC

Kenneth M. Suess

Abstract

The computer has been part of our technological society for only twenty-five short years, yet its impact has touched the lives of all individuals. The brief ten year history of the computerized data bank as it affects the privacy of all Americans is outlined. The proposal for a National Data Center, which made the American public aware of the real threat to individual privacy, was formulated in the mid-1960's. It was not until 1974 that landmark legislation occurred with the passage of the Privacy Act of 1974. Since this legislation is aimed primarily at government data banks, the public wants still more comprehensive legislation to protect it from data banks in the private sector. There is evidence to indicate that such legislation will be passed in the near future.

Suess, Kenneth M., "Computers, Privacy and the American Public," Technology Transfer in Science, Technology and Public Policy, pp. 71-81, 1978.

OFFSHORE TECHNOLOGY TRANSFER

Donald J. Looft

Abstract

With all of the advanced technologies the Defense Advanced Research Projects Agency (DARPA) is working on and the basic DARPA mission of minimizing the possibilities for technological surprise, one of the greatest concerns is inadvertent offshore transfer.

The technological advantages of the U.S. represent the fruit of long term national investment. They represent a vital part of the national security posture and are essential to maintaining the nation's economic well-being. The technological gains made are the keystone of the national productivity and, in turn, its wealth, its strength, and its standard of living.

A task force convened by the Defense Science Board examined in detail four representative high-technological industries: solid-state electronic devices, instrumentation, aircraft jet engines, and airframes. They found that the transfer of design and manufacturing know-how is of overwhelming importance to the national security. It is mastery of design and manufacturing that increases a nation's capability and it is in this area that the U.S. maintains its technological leadership.

Looft, Donald J., "Offshore Technology Transfer, IEEE Transactions on Industry Applications, vol. IA-13, no. 4, pp. 278-280, July/August 1977.

THINKING AHEAD: COMMUNICATIONS TECHNOLOGY--FOR BETTER OR FOR WORSE

Daniel Bell

Abstract

Computers, telephones and television are merging to provide faster, wider-reaching communications presenting new problems and new opportunities for business and society. New systems include: compunications or telematique (the merging of computers, telephones, and television into a single yet differentiated system), data processing networks (to register purchases through computer terminals as bank transfers), information banks and retrieval systems (to search for information and print out a legal citation, chemical abstract, market research material, etc.), teletext system (displays financial information, catalogs, classified ads, news, or weather on the home television) and others. These are developed technologies but the rate of introduction will vary as to basis of cost, competition and government policies. One important consequence of this revolution is that, because of the combination of market and political forces, new international division of labor in the world economy emerges. Another involves an expansion in the political arenas of the world. There are also the implications for personal liberty; expansion of "Big Brother" totalitarianism. There has already been an enormous growth of threatening powers of social

control by expansion of surveillance techniques, concentration of the technology of record keeping, and control of access to strategic formation by monopoly or government imposition of secrecy. The issues for liberty in the personal and economic sense are not in the technology per se but in the social and political system in which the technology is embedded.

Bell, Daniel, "Thinking Ahead: Communications Technology--for Better or for Worse," Harvard Business Review, pp. 20-22, 26, 28, 32, 36, 40, 42.

TECHNOLOGY: DICHOTOMOUS TOOL

T. G. Lombardo

Abstract

The Kama River truck factory in the Soviet Union is one of the world's largest industrial complexes. The United States and Western Europe contributed to its design, construction, and operations with shipments of equipment and transfer of technology from 1971 through 1975. The value of shipments from the U.S. alone, including an IBM computer to control the factory's foundry operations, totaled $355 million. When troops of the Soviet Union invaded Afghanistan in 1979, trucks supporting the Soviet military units were identified as products of the Kama River factory.

The case of the Kama River factory has lent immediacy to a long-simmering debate over the export of U.S. technology and advanced products. All U.S. equipment and advice that helped build the factory were exported legally.

The controversy is unceasing, but the invasion of Afghanistan has tipped the scales, temporarily at least, in favor of tighter controls. It has ended a period in which increasing amounts of technology and sophisticated products were being sold to the Soviet Union by the U.S. This paper explains the current issues and describes the U.S. Government's controls on the export of technology.

Lombardo, T. G., "Technology: Dichotomous Tool," IEEE Spectrum, pp. 51-54, May 1981.

EXPLODING A FEW MYTHS ABOUT PRODUCTIVITY AND PRESENTING A FORMULA FOR THE FUTURE

J. Fred Bucy

Abstract

Bucy attempts to destroy the myth that increases in output per man-hour lead to increases in unemployment. There is no doubt some short term loss of employment, but history shows conclusively that "productivity gains not only increase the standard of living but also increase the economy's ability to create jobs."

The other myth addressed is that the service sector is incapable of achieving high productivity gains. This failure is not due to the nature of the enterprise, but to a dearth of thinking directed at redesigning tools, processes, and organizations that "might figure out how to eliminate the conditions that require servicing in the first place."

The governmental barriers that Bucy believes responsible for strangling innovation and the removal of those obstacles may be summarized in this statement about the current socio-political situation. "The United States must acquire a more realistic understanding of the limits to which social change can be brought about through legal compulsion. Legislation, litigation, and regulation may be useful for achieving some social goals, but today government is regulating more than it can handle."

Bucy, J. Fred, "Exploding a Few Myths about Productivity and Presenting a Formula for the Future, IEEE Spectrum, pp. 45-47, October 1978.

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